The Radical Cure of Hernia

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By Henry O. Marcy, A.M., M.D., LL.

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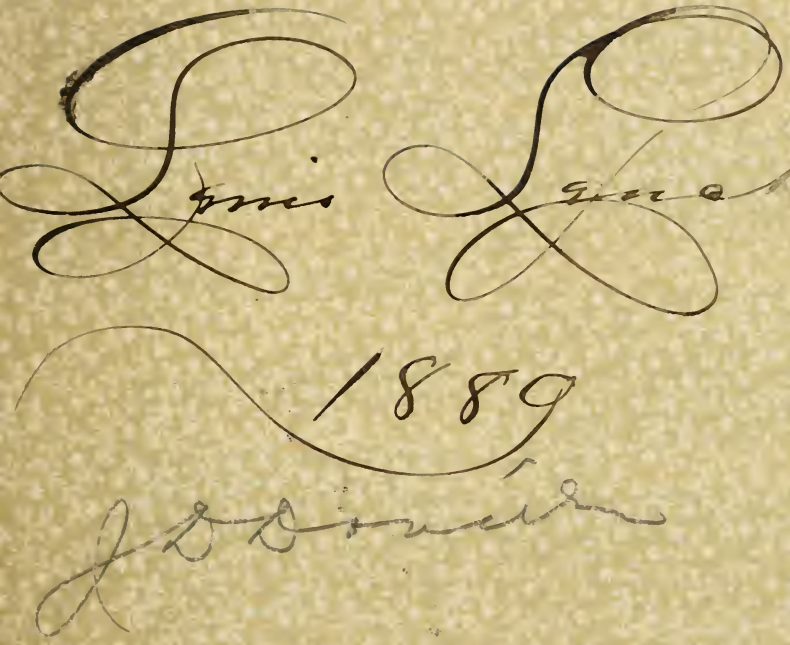

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Of BEEF EXTRACT, DR. PAVY says: "There are grounds for believing that "a considerable proportion consists of "products of proteid decay, materials "in course of retrograde metamorpho- "sis, that are of no use as nutritive "agents."

The well nigh superstitious ideas entertained by the *laity* of beef tea, is expressed in the allusion to the "*strength*" which is popularly supposed to be extracted in the *tea;* after which the *beef* is thrown to the dogs. The working man makes soup from a joint and consumes the "strength" and the *beef* both.

The medical profession insist that patients shall profit by the knowledge and progress of medical science, by the use of artificially digested fresh milk, etc. The Nostrum advertisers usurp functions of the physician by prescribing fictitious "foods for invalids," foods which medical science has long since condemned.

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A TREATISE ON HERNIA.

THE RADICAL CURE

BY THE USE OF THE

BURIED ANTISEPTIC ANIMAL SUTURE.

BY

HENRY O. MARCY, A. M., M. D., LL. D.,

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1889.

GEORGE S. DAVIS,

DETROIT, MICH.

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PREFACE.

This little book is offered the profession, as the outgrowth of special studies upon the subject of Hernia for the last eighteen years. In 1870 the author first operated for the radical cure of hernia by the open wound method, and the closure of the parts by the use of the buried animal suture. Based upon a series of experimental studies upon animals, undertaken for the purpose, it was believed to be demonstrated that aseptically applied animal sutures became so incorporated into the vital structures as to be, in large measure, replaced by connective tissue. The result of these investigations taught that the application of animal sutures, for the cure of hernia, is clearly of the first importance. Convinced that my own experience has demonstrated the truth of these opinions, I have taken pleasure in adding thereto, as far as possible, the views of modern surgeons, which I offer in the belief that the data is now quite sufficient to settle, with comparative accuracy, the question of operative measures for the cure of hernia, confessedly hitherto an opprobrium of surgery. If the teaching thus formulated shall guide to better results, and aid in placing measures undertaken for the cure of hernia upon a more established basis, the purpose for which this work was undertaken will have been accomplished. I am indebted to Dr. Joseph H. Warren, of Boston, for the loan of several electrotypes.

HENRY O. MARCY.

116 Boylston St., BOSTON, 1889.

CONTENTS.

CHAPTER I.

General Considerations on Hernia.

PAGES.

Definition of Hernia—Classification—Frequency as to Age, Sex, and Occupation—Baxter's and Kingdon's Tables—Causation—Congenital Hernia—Changes in Hernial Sac—Inguinal Hernia, Complete and Incomplete..... 1–13

CHAPTER II.

Formation of Hernial Sac.

Peritoneal Covering—Description of and Pathological Changes in the Peritoneum—Development of Inguinal Canal—Formation of Sac in Congenital Hernia—Encysted Hernia—Pathological Changes in Hernial Sac..... 14–31

CHAPTER III.

Anatomy—Descriptive and Surgical.

Anatomical Relations in Inguinal Hernia—Spermatic Vessels and Cord—Boundaries of Inguinal Canal—Oblique Inguinal Hernia—Contents of Inguinal Hernia—Reducible Inguinal Hernia..... 32–53

CHAPTER IV.

Instrumental Supports.

Trusses, French, English, American, Application of.. 54–58

PAGES.

CHAPTER V.

Irreducible and Strangulated Hernia.

Irreducible, Symptoms of—Strangulated, Pathological Factorage—Contents—Omental—Intestinal—Importance of Early Diagnosis and Prompt Relief.. 59–71

CHAPTER VI.

Surgical Procedures.

Operative Measures in General—Instruments Required in Herniotomy—Details of Operation—Treatment of the Wound after Reduction of the Strangulated Parts—Advantages of Resection of the Sac..... 72–88

CHAPTER VII.

Femoral Hernia.

Anatomy of Parts Involved in—Contents of—Recognition of Femoral Hernia—Operative Measures in Femoral Hernia—Author's Operation—Wood's Operation..... 79–112

CHAPTER VIII.

Obturator Hernia.

Anatomy and Contents of—Ischiatic Hernia—Umbilical Hernia—Operation in Strangulated Umbilical Hernia..... 113–127

CHAPTER IX.

The Radical Cure of Hernia.

History of the Various Methods of Treatment—Caustic—Punctum Aureum, Royal Stitch—Langenbeck's Method—Gerdy's Method—Use of Seton—Injection of Iodine—Dr. Warren's Modification of the Heaton Method — Wood's Method — Dowell's Method..... 128–164

PAGES.

CHAPTER X.

Radical Cure of Hernia by the Open Wound Method Under Antiseptic Precaution.

History of Animal Sutures — Advantages of the Author's Method of Operation by the Use of the Buried Tendon Suture—Review of the Open Wound Methods Employed in Europe — Prof. Socin's—Mr. Bank's—Mr. Frank's—Mr. Ball's—Mr. Macewen's—The Open Wound Treatment in America..... 165–213

CHAPTER XI.

Conditions Rendering Operative Measures Advisable.

In Children—In Adults..... 214–225

CHAPTER XII.

Method of Operation Advised.

Open Dissection Method—When to Operate in Femoral Hernia—Umbilical Hernia—Advantages of Open Wound Treatment—The Sac—Reconstruction of Canal by Buried Animal Suture—Treatment of Wound..... 226–238

CHAPTER I.

DESCRIPTIVE.

Hernia may be defined as the portion of the contents of any cavity projecting through an opening in its walls. However, surgically considered, unless otherwise stated, the term is usually restricted to the abdomen.

Abdominal herniæ are remarkable for their frequency, variety, and the danger attending them. They are produced by the protrusion of the viscera, contained in the abdomen, through the natural or accidental apertures, in the parietes of that cavity. The organs which form them most frequently are intestines and omentum.

Herniæ have been divided, according to the aperture by which they escape, into:

I. *Inguinal or supra-pubian herniæ.* These issue by the inguinal canal; they are called bubonocele when small, especially when concealed by escape into, rather than completely through the parietal wall; scrotal herniæ, when they descend into the scrotum in the male: vulvar or pudendal herniæ in the woman when they extend to the labia majora.

II. *Crural, or femoral herniæ,* when they issue by the femoral canal.

III. *Infra-pubian herniæ,* when the viscera escape through the opening which gives exit to the infra-pubian vessels, *hernia foraminis ovalis.*

IV. *Ischiatic hernia*, when it takes place through the sacro-sciatic notch.

V. *Umbilical hernia*, when it takes place at or near the umbilicus.

VI. *Epi- and hypogastric herniæ*, when they take place above or below the umbilicus in the linea-alba.

VII. *Perineal hernia*, when it occurs through the levator ani and appears at the perineum.

VIII. *Vaginal hernia*, when through the parietes of the vagina.

IX. *Diaphragmatic hernia*, when it escapes through the diaphragm.

Herniæ are likewise distinguished by their contents, as enterocele, epiplocele, etc.

Herniæ are also described as old or recent, and reducible or irreducible, incarcerated, strangulated, etc.

Abdominal herniæ are of very frequent occurrence, owing to the mobility and varying bulk of the viscera, the pressure which they experience, in all considerable efforts and motions of the body, from the muscles which in great part surround and enclose them; and the natural openings of the cavity are circumstances greatly facilitating the origin of such misplacements.

The importance of any given hernia is dependent upon the contents, the pressure exerted, and especially the impairment of intestinal function which may indirectly arise when the intestinal canal itself is not in-

cluded. When intestinal obstruction occurs, from any cause, life is imperiled, almost in a geometric ratio to its duration, a fact which cannot be too greatly emphasized.

The frequency of herniæ is quite greater than usually supposed. It has been variously estimated by surgeons of great experience, in the treatment of ruptures, that from one-eighth to one-sixteenth of the human race is afflicted with this complaint.

From the elaborate tables of Dr. J. H. Baxter, Surgeon U. S. A., we learn that the results of the examination of 334,321 "recruits, substitutes, drafted and enrolled men of various nativities," gave hernia as the cause of rejection in 17,296 cases, as seen in the following table:

DISEASE.	NUMBER REJECTED.	RATIO REJECTED.
Hernia, kind not specified	651	1,947
Hernia, umbilical	317	0,948
Hernia, ventral	328	0,981
Hernia, right inguinal	8,598	25,718
Hernia, left inguinal	5,420	16,212
Hernia, double inguinal	1,166	3,488
Hernia, right femoral	277	0,829
Hernia, left femoral	119	0,329
Hernia, double femoral	34	0,102
Total for hernia of all kinds	17,296	50,554

"From this statement, it appears that inguinal hernia was the cause of about eighty-two per centum of all rejections on account of hernia, and that the

cases of right inguinal hernia exceeded in number all the rest. Other tables confirm, in a most conclusive manner, this latter indication, to wit: that inguinal hernia of the right side is far more prevalent than that of the left. The cases of umbilical and ventral hernia were about equal, but inconsiderable in number as compared with right inguinal."

If we accept that the tables of Dr. Baxter afford any criterion of frequency of hernia, in the United States, the sum total of the individuals afflicted with hernia is not less than three millions.

Since the tables were based upon the examination of about half a million of men, within the limit of age to bear arms, a considerable proportion of the same presenting themselves to be examined for this purpose, it may not be considered as an excessive proportion of the entire population.

Malgaigne estimated the proportion of the whole population of France, which is ruptured, to be one out of every thirteen males, and one out of every fifty-two females; including both sexes, one in every twenty individuals.

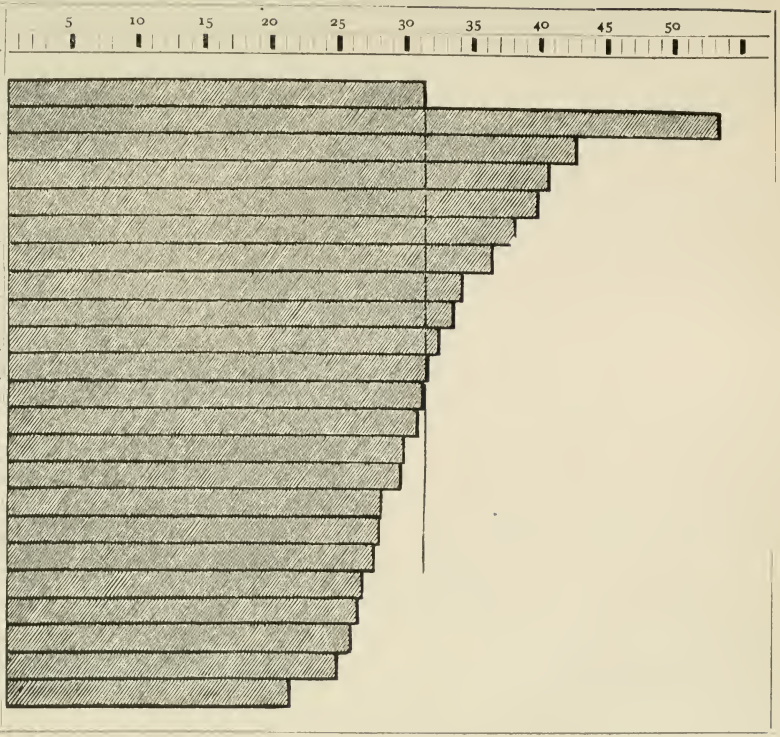
Sex.—There have been furnished no requisite data for comparison of the relative frequency of hernia in the two sexes.

Anatomically, the structures favor the liability of hernia in the male; the more violent exercise and severer labors of the male are also predisposing causes. It is generally conceded that hernia occurs

HERNIA

In its relation to Locality; showing the number examined, and the ratio rejected per 1000 examined.

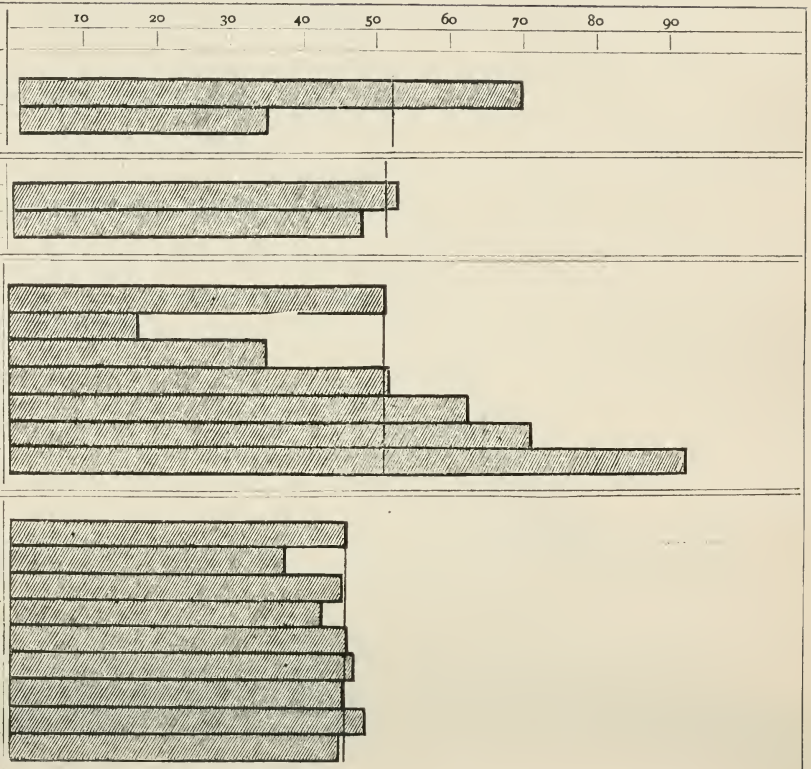
	STATES.	Number examined.	Ratio rejected.
	All States	501003	31 631
1	Minnesota	6489	34.246
2	Vermont	7224	43.051
3	Iowa	6846	41.046
4	Wisconsin	21945	40.283
5	Illinois	81126	38.398
6	Missouri	8576	36.381
7	Maryland	16920	34.043
8	Michigan	12179	33.418
9	New York	95576	32.738
10	Maine	20479	31 398
11	Indiana	29279	31.251
12	District of Columbia	6954	30.917
13	Kentucky	16028	29.760
14	Pennsylvania	12686	29.667
15	New Hampshire	10013	27 964
16	Ohio	37700	27.905
17	New Jersey	15388	27.359
18	Massachusetts	36380	26.883
19	Connecticut	11017	26.414
20	Delaware	6361	26.254
21	Rhode Island	4072	24.804
22	West Virginia	764	20.942



HERNIA

In its relation to Social Condition, Complexion, Age and Height; showing the number examined, and the ratio rejected per 1000 examined.

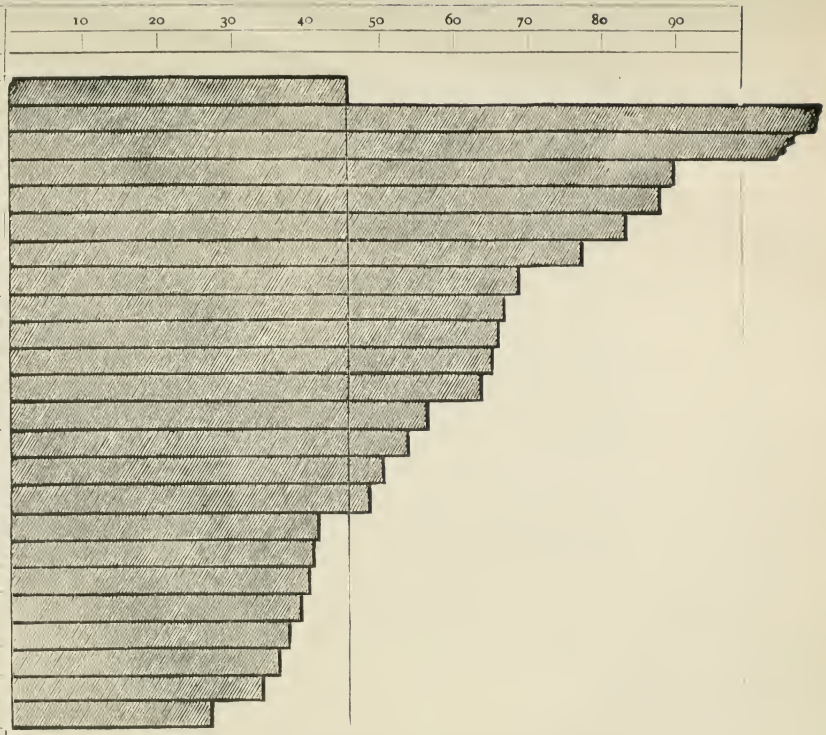
SOCIAL CONDITION.	Number examined.	Ratio rejected.
Married	159393	68.748
Single	174928	33.974
COMPLEXION.		
Light	217292	52.335
Dark	117029	47.244
AGE.		
All Ages	334321	50.554
Under 20 years	58952	15 913
20 and under 25	78639	34.576
25 " " 30	56711	50.837
30 " " 35	45777	61.659
35 " " 40	50456	69.902
40 and over	43786	91.604
HEIGHT.		
All Heights	501068	44.475
Under 61 inches	3747	36 296
61 and under 63	20838	44.006
63 " " 65	71038	40.357
65 " " 67	132087	44 698
67 " " 69	144650	45.897
69 " " 71	88792	44.588
71 " " 73	32313	47.442
73 and over	7603	43 404



HERNIA

In its relation to Nativity; showing the number examined, and the ratio rejected per 1000 examined.

	NATIVITY	Number examined.	Ratio rejected.
	All Nativities	501068	44.476
1	Portugal	81	123.457
2	Spain	148	114.865
3	Hungary	89	89.888
4	Mexico	91	87.912
5	Germany	54944	82.466
6	Italy	339	76.696
7	Switzerland	1802	68.257
8	Holland	989	65.723
9	France	3243	65.680
10	Poland	171	64.327
11	Denmark	383	62.663
12	Sweden	1190	55.463
13	Wales	1104	52.536
14	Russia	122	49.180
15	Norway	2290	48.045
16	U'd States (white)	315620	39.814
17	West Indies	380	39.655
18	England	16196	39.160
19	U'd States (colored)	25828	38.292
20	Ireland	50537	36.389
21	Scotland	3476	34.234
22	British America	21645	31.924
23	South America	79	25.316
24	U'd States (Indians)	121	.000



more frequently in the male. Out of a gross total of 96,886 applications for trusses at the City of London Truss Society, the males were 78,394, the females 18,492. Several authors give the proportion as about double in the male.

Frequency of Hernia at Different Ages.—According to M. Malgaigne, in three hundred cases examined by himself:

26	occurred	between	the	ages	of	10	and	20	years.
45	"	"	"	"	"	20	"	30	"
66	"	"	"	"	"	30	"	40	"
163	"	"	"	"	"	40	"	80	"

This record is, however, to be explained by the statement that the ages are taken from the entry of the visit of the patient, giving his age then, rather than when he first knew the disease existed. Mr. John Croft reports a table of 2,401 cases of hernia, of which 472 were in children, under five years of age. Mr. Kingdon, in the reports of the City of London Truss Society for the years of 1860 and 1861, tabulated 9,296 cases of hernia. Of these 60.8 per cent. had commenced before 35 years of age, and 39.2 per cent. after that age. Of the whole number, 2,516 were under five years of age.

An analysis of the following table from Mr. Kingdon's report shows that the percentage of herniæ in children is less than would at first appear, and that, relatively, hernia is more common after 35 than before this age:

AGE.	1860				1861				
	INGUINAL.		FEMORAL.		INGUINAL.		FEMORAL.		
	M.	F.	M.	F.	M.	F.	M.		
Under 1 year	473	27	....	....	563	37	....	....	1100
1 to 5 years.	181	17	....	....	192	26	....	....	416
6 to 10 years	91	23	3	1	112	16	2	....	248
11 to 15 years	115	19	4	2	133	19	3	6	391
16 to 20 years	284	27	3	14	291	38	8	15	680
21 to 25 years	348	30	18	31	375	33	18	37	885
26 to 30 years	381	45	21	58	424	50	20	54	1053
31 to 35 years	314	48	19	55	398	37	14	70	976
36 to 40 years	320	38	18	59	373	41	16	68	933
41 to 45 years	271	31	30	47	268	24	11	49	731
46 to 50 years	258	11	18	32	272	10	15	30	646
51 to 55 years	167	12	12	26	224	11	11	27	490
56 to 60 years	147	6	9	16	151	4	8	15	556
61 to 65 years	97	6	10	11	110	3	7	12	256
66 to 70 years	59	5	8	2	44	1	1	3	123
71 to 95 years	32	1	1	1	54	3	3	7	102
Totals	3558	346	174	355	3985	353	132	393	9296

KINGDON'S TABLES. REPORTS OF TRUSS SOCIETY, 1861 TO 1862. AGE AT DEVELOPMENT.

	1764
	981
	1938
	1909
	1377
	846
	379

Occupation.—It is generally accepted that the laboring classes are more liable to hernia. However, any reliable data are wanting to determine this, since all statistics from our large public institutions are based entirely upon the application of those whose

needy condition demands, in a measure, a public charity. The wealthier classes afford no opportunity for statistical knowledge. However, it is accepted that the general imperfect state of muscular strength and the lax condition of the tissues, dependent upon sedentary habits, render hernia more likely to supervene suddenly upon violent strain. Under such conditions, it is well known herniæ are very common, although a feeling of reticence makes reference to such suffering the exception.

Conditions. – Individuals suffering from hernia generally complain that they are much more troubled to retain the parts in position, when weakened or debilitated by disease. The tissues are relaxed and less able to sustain strain. It is also commonly observed that persons, deficient in general strength and tone, as age advances, become more subject to hernia. There is another considerable class, in both sexes, that, after the middle period of life, where a tendency to over-weight is marked, producing an increase of intra-abdominal pressure, become liable to hernia.

From infancy to old age, the abdominal cavity must be subject to daily variations in size and contents. The gaseous and fluid distention of the intestinal canal is often excessive; the omental and parietal fat frequently increases with great rapidity, and these conditions, of necessity, call into play a constant strain upon the abdominal supports which must be elastic and accommodative to movement. In wo-

men, the results of over-distension from pregnancy, violent muscular effort in parturition, a lack of proper tone and vigor of the parietal structures which frequently ensues upon delivery, must also be considered as causes of hernia, especially umbilical and ventral.

If individuals vary greatly in construction and composition, as to strength and firmness of their tissues, it seems but a natural consequence that such conditions should have a tendency to be transmitted to their descendants and, as will be seen later, congenital hernia is very common. A constitutional weakness, especially of the parietal peritoneum and of the mesenteric ligament has been advanced, even by some of our prominent writers upon the subject, as a cause of hernia. This is based upon the assumption that, otherwise, the small intestines could not be dragged down so as to reach below the rings or into the scrotum. My experience, in laparotomy, teaches me that the small intestines, are, as a rule, normally quite free to be carried below any possible escape through the base of the pelvis.

The anatomical relations of the mesentery to the intestine are primarily, less those of support than of limitations in physiological action. The vessels and nerves are not put on tension, but lie, without strain, with a certain, of necessity, freedom of motion. Remove the supporting power of the abdominal walls in any direction and, necessarily, the intestinal contents will follow. Were it otherwise, either a con-

siderable percentage of the people of all countries are congenitally malformed, or hernia is not caused, as commonly attributed, by over-strain, lifting, coughing, or any violent compression of the abdominal walls.

It is very probably true that a large proportion of the so-called immediate ruptures are preceded by a train of causes leading up to the giving away, at last, suddenly of the weakened ring, but even these could not increase the length of the mesentery, unless first the dimensions of the abdominal cavity were materially changed. In the so-called pendulous belly of multiparous women, the intestines easily follow to the very base, when the patient is in the upright posture, but I have yet to learn that the yielding of the recti muscles is supposed to be caused by the lengthening of the mesenteric ligament.

Constipation, dysuria, a harassing cough, are also direct, as well as remote, causes of hernia. It is the common experience of the ruptured, to ascribe the cause as due to violent muscular exertion. The contents of the hernial sac are those portions of the abdominal viscera subject to the widest latitude of movement and it may be owing to this, that it has been assumed necessary to have first an elongated mesenteric attachment, before the small intestine could form a part. Owing to this freedom of motion, portions of the omentum and small intestine, in the great majority of instances, form the contents, although portions of every abdominal organ have occasionally been involved in hernia.

When the large intestine is involved, the part protruded is, generally, either the cœcum or the sigmoid flexure of the colon, since these are less fixed than other portions of the canal. When the cœcum, it occurs usually, as we should expect, upon the right side; when the sigmoid flexure, upon the left; yet cases of the opposite are on record and also where both the cœcum and sigmoid flexure have been included in an omental hernia. In fleshy and elderly people, the omentum is generally heavily loaded with fat, and, on this account, the omentum is rendered more liable to become involved in hernia. Cases are on record where the bladder, uterus, ovaries, spleen, stomach, and kidney have been found in the hernial sac.

Herniaæ have sometimes been classified as external and internal—complete or incomplete. The former, when the abdominal contents protrude to form a tumor, obvious upon ordinary inspection; the latter, when some portion of the abdominal viscera is so displaced as to impair function, as, for example, when the bowel passes through an opening in the diaphragm or into some cavity, formed by peritoneal folds, or confined by bands of adhesion. All these changes are properly classified in a general work on hernia and will be noticed, at some length, in their proper place. They are often attended with very grave danger, since they are not easy to define, and may as surely obstruct the intestinal canal as when it escapes through an opening externally.

CHAPTER II.

Formation of sac.—Except in the rarest of instances, the hernial contents are enclosed in a portion of the parietal peritoneum, which is carried before them, and this constitutes the *sac;* a cavity continuous with that of the abdomen. At the outset, the size of the cavity is limited to that of the opening, which has generally a tendinous and comparatively unyielding border. Over the opening, however, the parts are usually soft and weak, often loose fascia and integument, and, little by little, the peritoneum stretches, under the pressure, into a bag of greater or less size and varying in shape, but communicating with its origin by the original opening, often not much changed, called the mouth or neck of the sac; the peritoneum at the mouth of the sac is intrafolded or plicated. When the contents of the sac can be returned, often the general functions go on unimpaired, the subject suffering only a limited weakness and inconvenience. Changes of vascularity and nutrition, however, generally soon ensue, the sac becomes thickened, adhesions of the contents follow, and a general increase of bulk takes place. So long as the contents of the sac can be returned, the hernia is called *reducible.* When the hernial contents can no longer be returned to the abdomen, although the suffering or inconvenience is not extreme, it is called *irreducible.* When from pressure, or constriction, the function of the

contents is suspended, the hernia is then *incarcerated*, or *strangulated*, and the narrow surrounding portion, usually at the neck, is called the stricture. The existence of a peritoneal covering, as a sac, is dependent upon the contents of the hernia being made up of organs within the abdomen proper, as the bladder could protrude entirely from below the peritoneal reflexion. Cystocele and rectocele, in a sense, are also hernial tumors, but without a peritoneal investing membrane.

Hernia also exists, without a peritoneal investment, in wounds; *e. g.* penetrating wounds of the abdomen, but, other than these, the peritoneum, more or less altered, is constant in hernia, as the chief component of the sac. The definition, earlier given to hernia as rupture, was dependent upon the belief that a sudden giving way of the enclosing parts generally included also an actual lesion of the peritoneum. The peritoneum lines the cavity of the abdomen and is reflected over all the organs contained in it, giving to each an external covering. This serous membrane is thin, semi-transparent, and perfectly smooth on its internal surface and is lubricated by a fluid which not only gives it a polished appearance, but permits movement of the organs upon each other and the restricting walls without friction. The texture of the membrane is of connective tissues, disposed in obliquely crossing layers which give it much strength and yet renders it of a yielding character; this is farther in-

creased by elastic tissue entering in a minor degree, into its composition. It is covered with a squamous epithelium and is very rich in vessels, nerves, and lymphatics. An interesting experiment is the dissection of a fresh peritoneum and securing it tense, like a drum-head. In this manner, it will support a considerable weight for some time and, upon its removal, return to its original shape. If longer retained, it will relax as a depressed pouch, and a careful observation will show that the structure has yielded by an irregular separation of its component layers. The texture and strength not only differ in different individuals, but notably in different parts of the same subject. Where it lines the abdominal walls it is thicker, grayish white, semi-opaque and nearly conceals the color of the adjacent parts; over the mesentery, on the contrary, it is often nearly transparent. To the linea-alba and the sheath of the recti muscles, the peritoneum is very closely adherent, but is loosely connected to the lateral abdominal parietes by a thin lamina of connective tissue. Its external surface is often rough and irregular.

Physiologically, it is subject to extraordinary changes, which are of much importance viewed from the standpoint of our present study, as evinced by the ever-changing peritoneal investment of the stomach, intestine, bladder, and the uterus in pregnancy; also the development of the peritoneum over a rapidly growing ovarian tumor, or the distension of the ab-

dominal wall, to several times its original surface in abdominal drospy. After such pathological changes, the peritoneum is frequently restored to its former normal state. In cases of sudden, forcible distension, particularly where the membrane is thin and adheres closely to the abdominal parietes, or other surrounding parts, its texture yields partially and undergoes a loosening, or species of laceration, such as in the case of silks or other stuffs we call fraying, the French éraillment, a kind of cicatrization follows, and leaves marks or lines behind, indicating the nature of the occurrence: "These éraillments," says M. J. Cloquet, "happen particularly when peritoneum, adhering to subjacent parts by a dense, close, cellular tissue, is dragged or displaced. Hence this partial laceration is frequent in the situation of the linea alba, from the distension of the abdomen and the separation of the recti muscles; and I possess several remarkable specimens of this kind. In the part which has been thus frayed, the peritoneum is preternaturally thin, representing a net-work of slender fibres, leaving irregular interspaces, which are filled by an extremely thin, transparent pellicle. This kind of change is observed, not only in the peritoneum lining the abdominal parietes, and that which forms the hernial sac, where it is very common, but also in the serous covering of the displaced viscera, in the mesentery and intestine when they have been dragged and elongated in large ruptures."—[Recherches' Anat., p. 48.]

"The locomotion or displacement, the extension or elongation, and the partial rupture or fraying of the peritoneum, account satisfactorily for the origin and increase of the hernial sac; and the two changes first mentioned explain sufficiently the great size which the bag sometimes attains. Scrotal ruptures may hang half way down the thigh and sometimes nearly reach the knee; yet the whole inner surface of the swelling, in which all the loose viscera of the abdomen may be contained, is lined by a continuation of the peritoneum without any laceration or interruption."*

M. J. Cloquet also made many experiments, upon the dead body, of much interest and value. "In some individuals the natural openings of the abdominal parietes are large and loose; if we push the finger through, the peritoneum is carried before it, forming a production which represents a hernial sac. Here the cellular tissue is not torn, but elongated. When the pressure is discontinued, the membrane gradually regains its original position. This experiment shows that the peritoneum is actually displaced in the formation of a hernial sac; that it leaves the neighboring parts to pass into the aponeuritic opening. The abdominal parietes lend the peritoneum which covers them to form the hernial sac. The membrane is hardly stretched, and it forms folds in the opening; in some instances, it is both displaced and elongated, covering the finger closely.

* A Treatise on Ruptures, by W. Lawrence, p. 29, 1843.

In other subjects, the peritoneum resists more forcibly, because it adheres more closely to the parietes; the portion, however, near to the tendinous opening becomes stretched; its laminæ separate and are partially torn and may thus form a very thin sac, different from that in the former instance, which has the material thickness of the peritoneum. The displaced membrane, in this case, does not recover its former position, and we find partial laceration in the fundus of the sac."*

The peritoneal sac may also be formed by causes acting from without. It is a common occurrence, a number of marked instances of which have come under my personal observation, where a large unsupported hydrocele has, by its dragging weight, caused the depression of the peritoneum at the upper orifice of the inguinal canal to become deepened and finally a well-marked hernia ensued. Cloquet cites an interesting case of an old man with a large inguinal hernia. "The sac was five inches long; its orifice was large and rounded, and its cavity was divided into two parts by a fibrous prominent ring. Below the latter, the peritoneum was thick, whitish, and strongly adherent to the external coverings; above, it was thin and transparent, as in the abdomen. The descent of the thickened ring and the elongation of the sac, had been obviously caused by the weight of a large hydrocele of the

*Reserches sur les Causes l'Anat. des Hernies Abdom.

tunica vaginalis, which adhered firmly to the lower part of the hernial tumor. A convolution of the small intestine, two inches and a half long and unadherent, occupied the upper division of the sac."*

I have dwelt at greater length upon the peritoneum and its relation to the hernial sac than is usually found in works on hernia, since it is not only interesting and important in the consideration of the causation, but, more especially, when we shall come later to emphasize it as a factor to be taken into account in the discussion of the methods for the cure of hernia.

Development of Inguinal Canal.— In the developmental processes of intra-uterine life, it is usually accepted that the gubernaculum testis, contracting, carries with it the testicle, the portion of the peritoneum which is to form the tunica-vaginalis, and the lower fibres of the obliqus internus which constitute the cremaster.

Between the fifth and sixth month of intra-uterine life, the gubernaculum testes attains its development. It completely fills the inguinal canal and lies behind the peritoneum anterior to the psoas muscle. According to Mr. Curling, the gubernaculum divides below into three processes; the external and broadest is connected with Poupart's ligament in the inguinal canal; the middle process descends along the inguinal ring to the bottom of the scrotum where it joins the dartos;

* Op. cit.

the internal one is firmly attached to the os pubis and sheath of the rectus muscle, some fibres are also reflected from the internal oblique on to the front of the gubernaculum. About the sixth month, the testis descends to the iliac fossa and the gubernaculum is shortened. During the seventh month, the testis enters the internal abdominal ring, carrying before it a pouch of the peritoneum, the processus vaginaiis. During the last month of pregnancy, the testis descends into the scrotum and the lengthened pouch of peritoneum is still open, communicating with the peritoneal cavity. Usually, at birth, the upper front of this pouch has become closed and the obliteration extends gradually downwards to within a short distance of the testis. This remains through life as a closed serous sac, the tunica vaginalis, which invests the outer surface of the testis and epididymis and is reflected over the inner surface of the scrotum. During the descent of the testis, the muscular fibres of the gubernaculum become gradually everted, forming a muscular layer, which becomes placed external to the process of the peritoneum, surrounding the gland and spermatic cord, and constitutes the cremaster. In the female, a small cord, corresponding to the gubernaculum in the male, descends to the inguinal region and, ultimately, forms the round ligament of the uterus. A pouch of peritoneum accompanies it, along the inguinal canal, analagous to the processus vaginalis in the male and this is called the canal of Nuck.

"In the majority of new-born infants, some portion of the vaginal canal still remains. In twenty-one cases Seiler found four in which it was open on both sides, five in which it was open on the right side, and four on the left. In fifty-three new-born infants, Camper found twenty-three open on both sides, eleven on the right, and six on the left. Schreger found in thirteen infants that the canal was open in eight on both sides. Paletta gives the rule, that the complete closure of the vaginal canal takes place from the twentieth to the thirtieth day after birth."* When closure does not take place, the condition known as congenital hydrocele may exist, *i. e.* the fluid from the peritoneal cavity gravitates into the non-closed tunica vaginalis, which becomes distended in a limited degree, as in hydrocele. The fluid gradually returns when in a recumbent position. This condition is often complicated with hernia, which, in this instance, follows through the funicular peritoneal opening, as in congenital hernia, although the hernia itself may not be acquired until in adult life. This condition is rare, but one well marked case has come under my notice where this condition had pertained since infancy and the canal was permanently closed under the irritation caused by a hard-pad truss. Sometime later, after a bath, in pulling himself, hand-over-hand, up into the port-hole of a ship, the young man produced

*A Practical Treatise on Hernia, by Joseph H. Warren Page 14.

a hernia which, however, was easily retained by a light truss. The hydrocele did not recur.

Congenital Hernia.—In congenital hernia, the sac is formed by the upper portion of the funicular process of the peritoneum, produced by the descent of the testis, remaining unclosed. In the arrested development, whatever the causes, the inguinal rings and the canal are weak and the depressed peritoneal pocket becomes the seat of increased intra-peritoneal pressure and, on this account, anatomically considered, congenital hernia must be of the oblique variety. The rings in infantile life, however. are more nearly opposed to each other than after development.

When the canal, formed by the descent of the testis, remains unclosed, the serous sheath is converted into the hernial sac. Haller first called the attention of the profession to this condition which was confirmed by John Hunter and Percival Pott. More than a century ago, the latter author wrote, "Ruptures of this kind are said to be very rare, but from what I have observed, both in the living and the dead, I am inclined to believe that they happen much oftener to adults than are suspected." While Scarpa observed "that it is impossible to turn the bottom of the hernial sac upwards in congenital hernia, as may be done in common hernia, leaving the spermatic vessels with the testicles in their situation; for it is not possible in congenital hernia, to raise and invert the bottom of the vaginal coat, forming the hernial sac, without raising

and, at the same time, turning the testicle upwards and the spermatic vessels which are inserted into it. Upon which point I cannot mention but with horror, the injury which, from the want of this knowledge, was practiced upon the celebrated physician, Zimmerman, from the false persuasion under which the surgeon labored, of being able to raise up the vaginal coat, without removing the spermatic vessels from their situation, and to tie it at its neck, in order to prevent the return of the hernia, according to an erroneous and already antiquated notion."*

Encysted Hernia.—The encysted hernia of Sir Astley Cooper, sometimes called the acquired congenital form, or the infantile hernia of Hey, is that where the ventral orifice of the sheath is occluded, but the canal remains open continous with the tunica vaginalis. The hernia is formed, as in the more common variety, by the sac consisting of the parietal peritoneum, but it is forced, with its contents, into the open tunica vaginalis.

I have not met with this form of hernia in operation, and, without dissection, it might not be diagnosticated. Sir Astley Cooper reports the following case, which he had the opportunity of witnessing under the care of Mr. Foster at Guy's Hospital:

"A man was admitted into the house with symptoms of strangulated hernia, which the usual means failed to relieve and the operation proposed and

*Warren, op. cit.

urged, but the patient would not permit, choosing rather to die. On examining his body after death, a sac was found within the tunica vaginalis, descending from the abdominal ring towards the testicle. This sac contained a portion of one of the small intestines, which had become gangrenous. The stricture was at the mouth of the sac." *

In the normal development, the serous canal, through which the testis has passed, becomes closed and is obliterated; when this has occurred the hernia can no longer escape by this tract, and the sac is now formed by a yielding of the peritoneum over the protruding parts. This is by far the more common condition.

CHANGES IN THE HERNIAL SAC.

In the protrusion of the peritoneum through an opening in the abdominal parietes it, at first, passes unchanged through the tendinous ring, which is more or less firm and resisting. This ring supports the mouth of the sac and determines its form and size. Since it passes generally through unyielding tissues, the neck is relatively small, while the body of the sac, comparatively unrestricted, is usually much larger. The direction, or axis of the sac, varies in its course, dependent upon the obliquity of its openings. The form of the sac is necessarily modified by the opening through which it escapes, by the tissues surrounding

* Cooper's Lectures, 1839, page 340.

it, and the resistance which is made to its progress. In consequence, the shape and size vary greatly as in scrotal, femoral, or umbilical hernia.

When the canal remains circular and tendinous, the sac has an elongated and a somewhat cylindrical shape. This is generally true in inguinal hernia when it is confined to the sheath of the spermatic cord. Having passed below this, the sac expands and may become globular or pyriform. On the contrary, when the sac has escaped through a direct opening in the abdominal parietes, the resistance is comparatively slight and equal in all directions, and the shape assumed is nearly spherical or somewhat flattened, as in umbilical hernia.

In an imperfectly formed inguinal hernia or bubonocele, the sac will be irregular and flat, often escaping detection, unless the examination is made with care. While the size and shape of the hernial tumor thus varies under the modifying influences of the surrounding tissues, these, in turn, are changed under the pressure; the apertures of escape being altered in size, length, and direction. "The thickness of the neck of the sac varies much. In small ones of a conical figure, the peritoneum retains its natural structure at this part, simply turning over and lining the aponeurotic ring. This is the least frequent case; more commonly, in passing through the narrow aperture, it is folded, puckered, contracted, and gains in thickness what it loses in extent of surface. The

whole circumference of the neck presents fine folds, radiated wrinkles, more or less numerous and approximated to each other. If we distend these folds they are seldom completely effaced, as the two membranous plates which form each of them become adherent; this puckering or gathering of the peritoneum necessarily increases the thickness of the neck of the sac. These folds are the rudiments of those which form when the mouth of the sac gradually contracts. It ultimately disappears, giving origin to radiated marks, disposed like the rays of a star and indicating the place of its former existence. * * * Sometimes the neck of the sac presents a rounded, whitish, almost fibrous, and very firm ring, either of uniform or varying thickness, in different points of its circumference."*

The changes which the neck of the sac undergoes are often very important in the consideration of operative measures for relief or cure. It is often adherent to the ring through which it escapes; rarely it is attached at one side only; the peritoneal pouch then becomes irregularly saccated, even two distinct pouches may form and descend below the ring, having a common opening into the abdomen. A sac, under the pressure of a truss, may be kept empty and become adherent and closed at its neck, and thus a cyst be formed. A closed sac developed in this way

* M. J. Cloquet, op. cit.

may become attached to a more recently formed hernia, and be itself carried down with the advancing tumor.

These conditions are fortunately very rare, but it should be kept in mind that they do occur, otherwise, when present they will greatly confuse the observer and render diagnosis of extreme difficulty.

The so-called spontaneous reduction and the cure of hernia under the pressure of a well-fitting pad, are subjects of much interest. Although M. Cloquet made his observations seventy years ago, none of greater accuracy or value can be quoted. "During the formation and growth of a rupture, the peritoneum passes, and seems in a manner to converge, towards the opening through which the parts escape. When elongated, so as to form a hernial sac, it still possesses its natural elasticity and contractibility, which coming into action when the distending force ceases to operate, sometimes produce slowly and insensibly this spontaneous reduction of the sac. The membrane, in such cases, takes a retrograde course; the portion lining the abdominal parietes, in the neighborhood of the ring, draws in all directions on the neck of the sac, which is thus distended, expanded, and at last effaced; the sac is, in a manner, unfolded and again covers the parts in the neighborhood of the aponeurotic ring. The neck, which is the part last formed, is the first to disappear, while the restoration of the fundus is the last step in the process, and is accomplished with difficulty; this kind of reduction is therefore often incomplete. If the neck of the sac is a fibrous ring, this becomes en-

larged, expanded, and disappears wholly or in part. Previously to reduction, it was applied closely to the distended ring, and of course possessed the same dimensions, but now it is much larger, and does not correspond to the part. The portion of membrane circumscribed by the larger circle, which it now forms, was the hernial sac. In the center of this circle I have found, in two instances, a depression of the peritoneum, formed by the fundus of the sac, still engaged in the aponeurotic opening. In these cases the spontaneous reduction has been incomplete; by drawing downwards the portion of membrane still in the ring, the enlarged neck was gradually brought back to the aponeurotic aperture and resumed its former dimensions. * * * Sometimes the sac is so completely effaced, that the peritoneum lining the ring shows no trace of its existence. The only proof that there has been a hernia is a whitish, cellular, empty cavity arising from the aponeurotic ring; this cavity formerly lodged the peritoneal sac and is ready to receive it, if it should be formed again. This mode of reduction must be tolerably frequent, in recent herniæ, when the peritoneum constituting the sac has not had time to assume a texture in conformity with its new position. It will be favored by the pressure of a truss on the ring, or by the patient remaining constantly in a recumbent position. This reduction of the sac will be much more difficult, and often impossible in old ruptures. The elasticity and contrac-

tility of the peritoneum lining the abdominal parietes are counterbalanced and surmounted by the resistance of the fibrous neck of the sac, by the disposition frequently observed in that neck to contract, by its adhesion to the aponeurotic opening, and the firm connection of the sac to the neighboring parts. The weight and pressure of the viscera, when they continue protruded, act together with the causes just enumerated, in opposition to the contractility of the peritoneum and consequently to this mode of reduction."* The hernial sac may be drawn upwards within the abdominal cavity, by the distension of the bladder from retention of urine; by the enlargement of the uterus in pregnancy; by the formation of other herniæ in close proximity to the first.

The pathological changes which may take place in the sac are various; direct injuries, wounds, bruises, pressure from improperly fitting trusses, any violence may cause here all the conditions usually ascribed to inflammations elsewhere. Serous, bloody, and turbid secretions may occur. From a variety of causes, the sac may become infected and purulent collections ensue. The sac itself becomes thickened and changed so as to lose all the appearances of a serous membrane. I have recently removed the sac in two cases where it was several lines thick. One, an old hernia, so slight as to give little trouble until, suddenly,

* M. Cloquet, Op. cit.

strangulation of the intestine supervened by the escape of a loop through the ring. The second, of oniy three months' standing, and yet the hernia was scrotal and the omentum adherent to the much changed walls of the sac.

CHAPTER III.

ANATOMY—DESCRIPTIVE AND SURGICAL.

The cure of hernia by surgical interference is the restoration of the parts involved, as nearly as possible, to a normal condition. To do this intelligently, presupposes a thorough knowledge of what we mean to restore. To this end, the anatomical construction of the parts involved must be carefully mastered. Fortunately, there is little need of original work. The great teachers of former generations have gone over the entire field with such pains-taking care, born of enthusiastic zeal, that little can be gleaned that is new, or of especial value. The works of Camper,* Cooper,† Scarpa,‡ and Cloquet ‖ will ever be considered as monuments of industry and accuracy.

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* Icones Herniarum, Peter Camper, 1801. The plates were engraved in 1757.

† Sir Astley P. Cooper, 1804 and 1807.

‡ H. Scarpa, 1812.

‖ J. Cloquet, 1817 and 1819. §

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§ The latter was published as an inaugural thesis, and the descriptions are based upon the examination of three hundred and fifty cases of hernia found in about five thousand cadavers, covering a period of three years of hospital experience in Paris. In 1819 he published "Recherches sans les causes, et l'anatomié des hernies abdominalis," with ten plates. This is based upon five hundred post-mortem examinations, also two hundred anatomical preparations of hernia presented to the Faculty of Medicine in Paris.

Many others have also furnished contributions of great value, until now the anatomy of hernia leaves little to be desired. The recent work of Dr. Joseph Warren, of Boston, is the most complete and satisfactory of any American author. The present chapter will be as concise as the importance of the subject will admit.

INGUINAL HERNIA.

The construction of the abdominal walls is a beautiful example of nature's marvellous adaptability of means to the end to be subserved. The abdomen must be always full, no matter how varied its contents, and subject to equable pressure. The amount of pressure varies with contents, position of the body, and muscular contractility of the abdominal walls. For obvious reason, the tension is greatest at the lowest portion of any supporting cavity. This would be the pelvic basin but for the disposition of the bony structure of the trunk, where the relation of the incline of the brim of the pelvis to the projection of the sacrum throws the abdominal weight forward, and lessens materially the strain upon the floor of the pelvis.

The firm attachment of the recti to the ossa pubis is the first point of support, and this rarely fails in man, only exceptionally in multiparous women, or after long distension by abdominal tumors. The power and tension of the recti muscles are well illus-

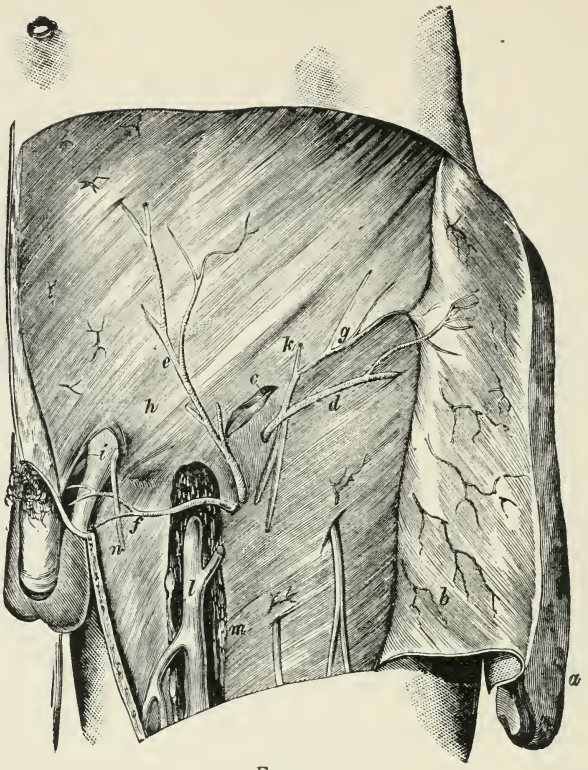

FIG. 1.

Superficial dissection of inguinal and crural regions. Below the groove upon front of thigh is seen the triangular depression forming the lower part of groin. This is described in connection with Femoral Hernia. Above the pubis may be felt the opening, in the deep parts, of the superficial abdominal ring through which the spermatic cord escapes to testicle. Beneath the skin of groin and fascia superficialis are two layers, between which are found the superficial vessels and lymphatics. The layer below this is made up of elastic areolar tissue and fat, closely attached to Poupart's ligament at spine of pubis and crest of ilium, *g*. Crossing the groin are seen three blood-vessels turned obliquely inwards and upwards from common femoral artery. Outer one, superficial circumflex iliac, passes up to superior iliac spine, *d*. The middle one, superficial epigastric, supplying glands and integuments of groin to umbilicus, *e*. Inner one, *f*, superficial external pubic, enters fascia lata near the pubis, crossing beneath spermatic cord to scrotum and root of penis. The external pubic is liable to be divided in cure of Inguinal Hernia ; if a dull bistoury be used in making the division, hæmorrhage is less liable to occur, unless the vessel is very much enlarged, which is the case sometimes in old and large ruptures.

The abdominal wall is made up of layers of muscular and aponeurotic tissue below the iliac crests. The external oblique is very strong, and the fibres curve downwards and inwards towards median line and pubis, forming with other tendons a vertical line and by union with opposite side linea alba.

trated by the marked resistance to pressure seen in laparotomy in subjects where the recti have not undergone overstrain. Even when the patient is fully etherized, they are so unyielding as frequently to be a cause of trouble to the operator in reaching the bottom of the pelvis.

In hernia, we have to deal with the rectus simply as a point of support. The abdominal fascia, first described by Camper, is in two layers; the superficial is thick and meshed, containing adipose tissue; the deep layer is aponeurotic and firmly adherent to the parts beneath. It blends with and goes to make up the linea alba, and extends below to Poupart's ligament. There are only three pairs of muscles which demand our attention: the external oblique, the internal oblique, and the transversalis.

The external oblique arises on either side from the eight lower ribs, passes towards the front of the abdomen, and joins in a broad tendon anteriorly. This union, in a broad aponeurosis, extends from the ensiform cartilage to the pubis, partly on the side from which it originates, and partly on the opposite side; it is also inserted into the spine of the ilium.

As the fibres of the lower and thicker part proceed obliquely downwards and forwards, they separate about an inch and a half from the pubis into two distinct portions, which constitute the pillars or columns of the abdominal ring. The upper and inner of these, which is broader than the other, is attached to the

upper edge of the pubis, near the symphysis; some of its fibres descend and decussate with those of the opposite side, being fixed to the fibro-cartilage which unites the two bones. The lower and outer, which is narrower, but, at the same time, thicker and stronger than the other, runs obliquely from above downwards, and from behind forwards, to be fixed by a strong tendon in the spine, or tubercle and crest of the pubis.

The portion of the aponeurosis, which extends between the anterior spine of the ilium and the spine of the pubes, is a broad band, folded inwards and continues below with the fascia lata: Poupart's ligament, sometimes called the crural arch. The portion reflected backwards and inwards from Poupart's ligament to the pectineal line is called Gimbernat's ligament. The triangular opening formed by the two tendinous columns at their insertion is known as the external abdominal ring. Through this the spermatic cord passes in the male, the round ligament in the female. The opening is directed obliquely upwards and outwards, corresponding with the same course of the fibres of the aponeurosis. The crest of the pubis is the base of the triangle, the two pillars form its sides, the juncture of the pillars the apex, which is strengthened by connecting fibres, curved from above downwards. These crossing, interlacing fibres are sometimes particularly strong in old herniæ, are better developed in men than in women, and are occasionally wanting. Although this opening is called a

FIG. 2.

Deep dissection of inguinal canal and abdominal wall. *a*, external oblique thrown back over Poupart's ligament ; *b*, internal oblique ; *c*, transversalis muscle ; *d*, conjoined tendon ; *e*, rectus muscle ; *f*, transversalis fascia ; *g*, triangular aponeurosis formed by a layer of fibrous tissue passing across linea alba from aponeurosis of external oblique of opposite side. These fibres pass outward and downward to pubic symphysis, crest and spine, or even to pectineal line, where they are implanted with those of the conjoined tendon ; *h*, muscular fibres of the cremaster.

The fascia transversalis, uniting at the groin with fibres of the tendon of the transversalis muscle, is closely connected with Poupart's ligament, iliac fascia and conjoined tendon. Here it forms the oval opening of the internal abdominal ring and gives off over the cord, the funnel-shaped investment called the fascia propria or infundibularis, *i*.

ring, it is never one unless dilated by a hernia. In its longest diameter it measures about one inch, from one tendon to the other only about half an inch. The centre of the opening is about one inch and a quarter from the symphysis. A very delicate fascia originates from the tendon of the external oblique at the upper margin of the ring, passing over it and uniting with the spermatic cord, which it accompanies in its descent into the scrotum and to it is closely adherent.

The internal oblique muscle arises from the outer half of Poupart's ligament, the crest of the ilium and the lumbar fascia. The lower edge of this muscle passes over the spermatic cord and blends with the transversalis to form the conjoined tendon of these muscles. It is inserted into the six lower ribs, ensiform cartilage, and linea alba. The conjoined tendon of the internal oblique and transversalis is inserted into the crest of the os pubis and pectineal line immediately behind the external abdominal ring, and serves to protect what otherwise would be a weak point in the abdominal wall. Sometimes the pressure from within is so great upon this tendon, that it fails as a support, and is carried in front of the hernial sac, through the external ring, and then forms one of the coverings of direct inguinal hernia.

The transversalis muscle, in its lower portion, arises from the outer third of Poupart's ligament and the crest of the ilium, and is inserted into the linea alba. The lower fibres curve downwards and are

inserted, together with those of the internal oblique, into the crest of the os pubis and pectineal line forming the conjoined tendon already described. The triangular ligament is a band of tendinous fibres which is continued from Poupart's ligament, at its attachment to the pectineal line upwards and inwards, beneath the inner pillar of the external ring, to the linea alba. The transversalis fascia covers the space between the lower border of this muscle and Poupart's ligament. This fascia lies between the transversalis muscle and the peritoneum. It is a part of the fascia which lines the interior of the abdominal and pelvic cavities, with which it is directly continuous. In the inguinal region, this fascia is thick and dense and is attached externally to the femoral vessels and to the posterior margin of Poupart's ligament. It also forms the anterior wall of the crural sheath of the vessels as they descend into the thigh.

The internal abdominal ring penetrates the transverse fascia, midway between the anterior superior spine of the ilium and the spine of the pubis, and about half an inch above Poupart's ligament. It is oval in shape, and varies in size in different individuals, being much larger in the male than in the female. It is limited above, by the arching fibres of the transversalis, and internally, by the epigastric vessels. About its circumference, a thin, funnel-shaped membrane is formed from the transversalis fascia which is continued around the cord and testes and encloses

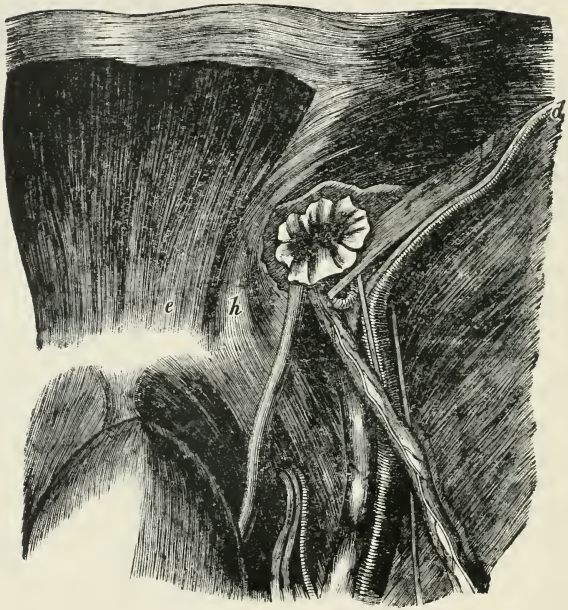

FIG. 3.

Dissection from the peritoneal surface of the parts affected by an oblique rupture; peritoneum, its fascia and the transversalis fascia are removed. The sac is cut off at its neck in the deep ring. The epigastric artery is seen below the neck, but has been removed at the inner side to show conjoined tendon, *h*.

them in a distinct sheath. In an oblique inguinal hernia this fascia forms one of the coverings of the sac. This fascia is loosely connected to the peritoneum and in fleshy persons often a layer of fat is here found.

The inguinal canal contains the spermatic cord in the male, and the round ligament in the female. It is about an inch and a half in length and extends obliquely downwards and inwards, parallel with, and a little above Poupart's ligament. Through the internal abdominal ring, it communicates with the abdominal cavity and terminates below at the external ring. In its entire length, it is limited, in front, by the aponeurosis of the external oblique, in the outer third, by the internal oblique, behind by the conjoined tendon of the internal oblique and transversalis, the triangular ligament and the transversalis fascia, below by the union of this fascia to Poupart's ligament. Oblique inguinal hernia always follows the line of this canal.

"The finger should be introduced a slight distance into the external ring, and if the limb is extended and rotated outwards, the aponeurosis of the external oblique, together with the iliac portion of the fascia lata will be felt to become tense, and the external ring much contracted; if the limb is, on the contrary, flexed upon the pelvis and rotated inwards, this aponeurosis will become lax, and the external ring sufficiently enlarged to admit the finger with

comparative ease; hence the latter position should always be assumed in cases where taxis is applied for the reduction of an inguinal hernia, in order that the abdominal walls may be as much relaxed as possible."*

SPERMATIC VESSELS AND CORD.

The spermatic vessels placed behind the peritoneum, descend from the loins, over the surface of the psoas and iliacus internus muscles, and are connected to them and to the membrane by loose cellular substance; and arrive at the division between the two portions of the fascia transversalis. Here they are joined at an angle more or less acute, by the vas deferens, and the spermatic cord, which results from this junction, making a sudden bend inwards, passes into the inguinal canal through its upper or inner aperture. The vas deferens is placed in the canal behind and towards the inner side of the vessels, and consequently under the fleshy margin of the obliquus internus and transversus, the exact situation of its passage being marked by a slight depression of the peritoneum. The cord thus goes obliquely downwards and inwards, between the fascia transversalis and the aponeurosis of the external oblique, being increased in size by the addition of the muscular fibres, called the cremaster muscle, derived from the lower edge of the internal oblique and from the crural arch. The

* Gray's Anatomy, p. 694.

cord finally emerges through the opening in the tendon of the obliquus externus, and then turns suddenly downwards; lying not so much on the bone between the two columns of the rings, as on the outer column itself, so as to cover the insertion into the pubes.

Thus the vessels of the testicle, making two remarkable turns, pursue three different directions in the successive parts of their course.

They descend, inclining at the same time a little outward, from the loins to the opening in the fascia transversalis. Then they bend inwards and forwards between that fascia and the aponeurosis of the external oblique, making a curve, of which the concavity is turned towards the pubes; the vas deferens makes a sharp angular turn at that part. The spermatic cord makes a second turn, with its convexity towards the pubes, and lastly, descends straight to the testicle."*

The cord, besides the vas deferens, is made up of arteries, veins, nerves, lymphatics, a membranous sheath, and the cremaster muscle. The spermatic artery is given off from the aorta a little below the superior mesenteric branches. Opposite the middle of Poupart's ligament, it passes from the lower part of the abdomen and joins the cord running to the testicle.

The spermatic vein, arising from the testis, returns along the cord to the abdomen. Two small

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* Lawrence on Ruptures, p. 160.

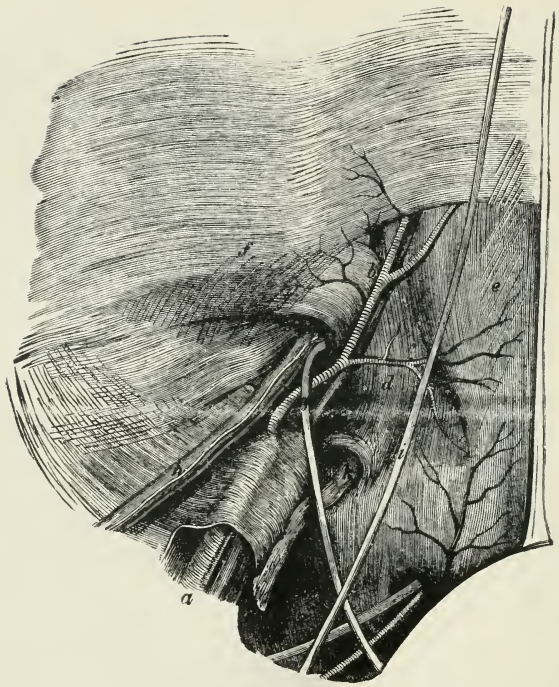

FIG. 4.

Dissection of Inguinal and Crural Hernia from internal surface, the peritoneum and fascia being removed. *a*, external iliac artery; *b*, epigastric artery, branch of *a*; *d*, deep circumflex iliac, lying in Hesselbach's triangle; *e*, rectus muscle; *f*, fascia transversalis; *g*, vas deferens or spermatic duct; *h*, spermatic plexus of veins with artery and nerves; *i*, obliterated cord of hypogastric artery; *k*, lymphatic glands. At the internal ring may be seen subperitoneal fascia, *l*, enveloping the cord, *h*.

arterial branches are also generally a part of the cord, one from the internal iliac accompanies the vas deferens, the other a branch of the epigastric. An accurate knowledge of the course of the epigastric artery is essential in operations for hernia, since it is situated so near the spermatic cord. This vessel arises from the iliac artery, behind Poupart's ligament and passes upwards and inwards close to the under and inner side of the cord, between it and the symphysis. Here it gives off a branch to the cord. For nearly two inches of its course it lies posterior to all the abdominal muscles, beneath the peritoneum. It ascends obliquely and upwards to the margin of the sheath of the rectus muscle. In its course, it lies behind the inguinal canal, to the inner side of the internal abdominal ring and immediately above the femoral ring. The epigastric varies considerably in its origin and branches. The position of the artery, concerned in hernia, is the beginning of its course, close to the inner and under side of the spermatic cord where the latter issues from the internal ring. Here the artery is generally three inches from the symphysis pubis, and is the same distance from the spine of the ilium.

The artery is accompanied by veins of which the largest is constantly found on the inner side of the artery. They end by a single trunk in the iliac vein.

As will be seen from the foregoing description, the inguinal canal is not an open, but a closed passage

through the abdominal walls; a passage for the transmission of important vessels, but so fortified by fascia, muscle, and tendon, as to hold its walls normally in close apposition, bringing intra-abdominal pressure to bear, not in line with its opening, but at a wide angle to it. Pressure thus disposed can never make an oblique inguinal hernia, but the rather will close the canal. A beautiful illustration of this is seen in the passage of the ureter, obliquely through the bladder wall.

"A simple contrivance gives a very clear idea of the manner in which the inguinal canal is formed. Let one take two slips of paper and cut two small holes in the centre of each. Let him then lay these holes opposite each other, and pass through them a quill or pencil case. When he has done this he has a very good plan of the state of the parts about the groin in the fœtus. If he now holds the papers opposite him and then pulls to one side the one nearest to him, he will find by so doing he comes to lay the quill between the pieces of paper in the same way that the spermatic cord, by the extension upwards and outwards of the internal orifice of the ring, comes to be lodged in the canal. He will also see that the length of the canal must vary according to the greater or less extension of its posterior side. On pages 56 and 69 of the present work, it will be seen that the author has expressly stated that the inguinal and femoral canals are not properly canals unless dis-

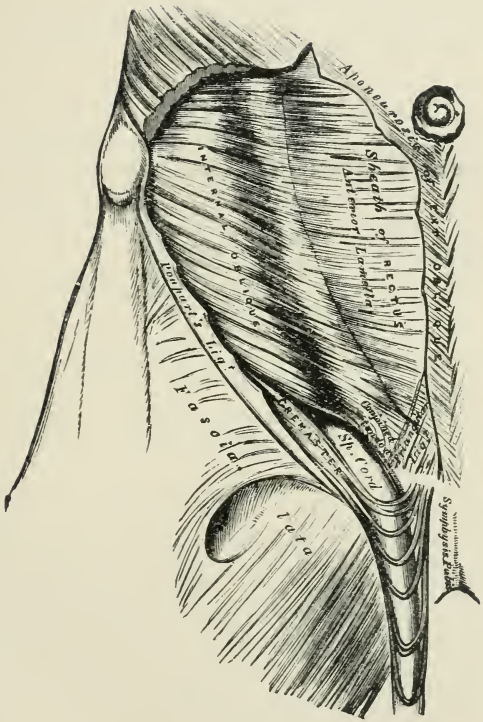

FIG. 5.

Inguinal Hernia, Showing the Internal Oblique and Cremaster Muscles, and Spermatic Cord.—GRAY.

tended by a hernia. In a normal state they are simply flattened passages."*

As described by Dr. Darling, the inguinal canal has the following boundaries:

Structures in front	Skin. Superficial fascia (2 layers). External oblique (entire length), Internal oblique (outer third).
Structures behind	Conjoined tendon of internal oblique and transversalis. Transversalis fascia. Triangular ligament. Sub-peritoneal tissue and fat. Peritoneum.
Structures above	Fibres of internal oblique. Fibres of transversalis.
Structures below	Poupart's ligament. Transversalis fascia.

OBLIQUE INGUINAL HERNIA.

From the anatomical description already given of the inguinal canal, we can readily see that a modification of the intra-abdominal pressure, diverting it in the line of the opening, is necessary at its very inception. We dwelt in detail upon the various changes which take place in the peritoneum in the formation of the sac. It is now much more generally accepted than formerly by anatomists and surgeons, that, in a

* Joseph Warren, Hernia, Sec. Ed. Page 6.

very large proportion of cases of inguinal hernia, taking the direction of the cord, its predisposing factor is found in the defect of the imperfect closure of the peritoneal pouch which descends before the testis.

In classification, this variety has been sometimes called congenital hernia, a term, as generally used, sufficiently accurate. The irregular depression in the peritoneum thus left at the internal ring, affords a slight obstruction to the free movements of the abdominal organs. Thus, little by little, the thin, yielding peritoneum is saccated and a wedge-shaped pressure, at first slight and interrupted, is formed in the line of the canal.

This pathological factorage having been established, it is easy to understand that a comparatively slight force is ample to separate the structures which make up the canal. The thin margin of the conjoined tendon yields, and then the force is brought to bear upon the external ring of the canal, protected posteriorly only by the aponeurosis of the fascia transversalis and the triangular ligament. Externally, the upper border of the canal, protected by its reenforcing fibres which give great support to resist forces acting from without, is yet imperfectly constructed to restrain an impinging force acting from above downwards.

When the contents of a hernial tumor have thus distended and distorted the inguinal canal, the im-

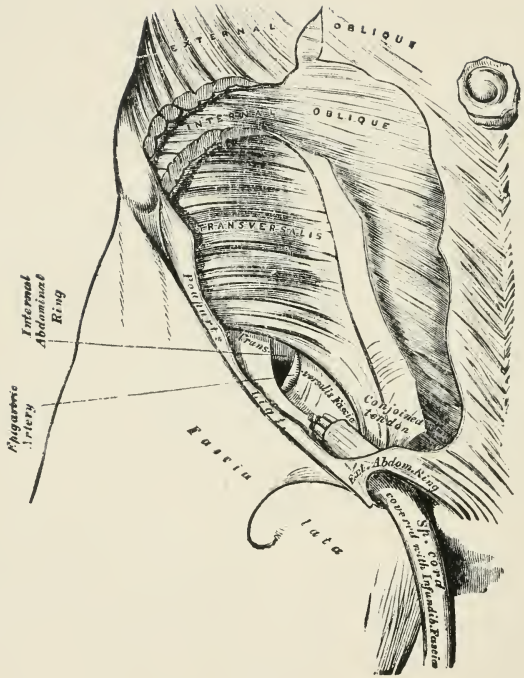

FIG. 6.

Inguinal Hernia, Showing the Transversalis Muscle, the Transversalis Fascia, and the Internal Abdominal Ring.—GRAY.

portant barrier to its further progress is overcome. The peritoneal sac protrudes over the spermatic vessels and separates them from the delicate fibres of the cremaster and superficial fascia. The contents of the tumor, unrestrained, oftentimes almost by gravity, find their way into the scrotum. For convenient differentiation, the tumor thus situated is called scrotal hernia. Not rarely, the tumor, formed in this way, becomes of very considerable size, sometimes enormous. "One of the largest of these swellings which I have ever seen was in a man who was sent to me at Guy's Hospital by Mr. White, surgeon at Lambeth. It reached to the patient's knees; its length was then twenty-two inches, and its circumference thirty-two."*

When inguinal hernia has existed for a considerable time, unrestrained, the constant pressure dilates the parts in all directions. The opening, through which it passes out from the abdomen, yields more readily toward the median line, until, at length, in old and large herniæ, the opening of the sac is in close approximation to and nearly opposite the external ring.

When the tumor is intestinal, it is elastic and uniform in feel, and when returned into the abdomen generally produces a gurgling sound.

When its contents consist of omentum, it is usu-

*Sir Astley Cooper, Op. cit.

ally irregular in shape, gives an indefinite doughy or inelastic feel and, if pushed up through the canal, emits no sound. Usually the inguinal hernial tumor is composed of both omentum and intestine—entero-epiplocele. The differentiation, however, is generally not difficult.

This form of hernia is by far the most frequent, occurring more often than all the other varieties combined, and is found oftener upon the right than the left side.

Hernia is usually easily diagnosticated. Hydrocele, hematocele, varicocele, cysts upon the cord, enlarged testicle are all to be considered as possibly confusing or complicating the diagnosis.

REDUCIBLE INGUINAL HERNIA.

Under this division may be included by far the larger number of the ruptured; the great army of semi-disabled, truss-bearing individuals of every generation and race. The protrusion, more or less marked, gives a sense of weakness and discomfort never absent, but varying greatly in degree. In the recumbent position, pressure upon the protruding parts causes them to be returned into the cavity of the abdomen. In the larger proportion of cases, a properly fitting truss retains the hernia.

Often, however, after unusual exertion, the tumor becomes large and its reduction is attended with difficulty. The individual, with such infirmity, lives in

constant danger. Accidents in great variety, often from the most trivial cause, may produce a strangulation of the prolapsed intestine, the consequences of which will be fatal, unless early relieved by skillful attention. To prevent this, as far as possible, and make comfortable, rather than to produce a cure, the truss has been devised.

CHAPTER IV.

INSTRUMENTAL SUPPORTS.

It is not my purpose in this treatise to enter into a detailed description of, or especially to differentiate between instruments of support. Although the variety of trusses seems almost infinite, when the stock of a large dealer is examined, certainly confusing to the young or inexperienced, new patterns being constantly offered as possessing some hitherto unknown merit, little real advance in the art of truss making has taken place since the days of Sir Astley Cooper, nearly a century ago. After discarding the use of all other supports and bandages, as of no value, often of damage, he describes a truss as follows:

"A steel truss is composed of a pad made of a supporting piece of iron, and stuffed so as to take a conical form, the apex of which immediately compresses the abdomen at the part whence the hernia threatens to descend. The pad is riveted upon a long flat piece, tempered to a great degree of elasticity, and curved to the shape of the lower part of the body, which it embraces, like a belt. The length of this steel should be sufficient to pass from the hernia round the region of the groin to about an inch beyond the spine behind, forming somewhat more than a semi-circle, but compressed. Both the pad and truss are quilted with leather. A strap of leather

proceeds from the hind end of the truss, which passes round the body, completing the circular belt by fastening upon the pad. * * * Many surgeons, and almost every surgeon's instrument maker, have thought proper to vary the form of the truss, and to prescribe different rules for the duration and force of the pressure, but almost all have agreed in determining that the pressure should be made upon the abdominal ring.

This is precisely the circumstance, however, in which they are all defective; and, indeed, it is the frequent failure of the purpose for which they are designed, when made according to this principle, that has led to such a variety in the mode of their construction. The object in applying a truss is to close the mouth of the hernial sac, and destroy its communication with the abdomen; and this object can never be perfectly fulfilled by any truss which is applied in the usual manner upon the abdominal ring, and extending from it upon the os pubis. In this case the cure must be incomplete, because a considerable portion of the hernial sac remains uncompressed towards the abdomen, which portion is that situated between the abdominal ring and the opening of the sac into the cavity of the belly."*

Even when the truss has been worn, apparently successfully, for some time, over the ex-

* Sir A. Cooper, p. 14.

ternal ring, should this become closed under the pressure, the neck of the sac is left open to receive the wedge-like dilating force of the abdominal organs, and the supposed cure soon fails. Not seldom, the pressure is directed so low as to injure the cord, interfere with the nutrition of the testis by disturbed or impeded circulation, and cause severe suffering. If cure is to be effected by a truss, it must bring, and continue to hold the sides of the mouth of the sac together, so as to prevent its being opened by the insinuation of the viscera, and in time cause adhesion, and obliteration of the sac.

Such cases occur, but are the decided exception and are usually in the young.

The surgeon should not only practically understand the proper method of fitting a truss, but should consider it a personal duty to see that. the instrument is rightly applied, of suitable strength, a well-fitting pad, and should give the sufferer the requisite details of instruction as to its wearing. It is also well to imform the patient that it will require time to render the support fairly bearable. The skin, under the pad, will need attention for some time, as friction and soreness ensue. Often a fold of India silk, as for example, an old handkerchief is of the greatest comfort. Individuals, after the middle life, may not expect a cure and should be taught to look upon a truss as a part of the impedimenta of subsequent living.

We cannot do better than emphasize the direction

of Sir Astley Cooper, to make the pressure over the internal ring, and, as a rule, not with a large pad. A small well-fitting pad which the proper adjustment of the truss will allow to be retained over the exit from the abdomen is the end to be attained. While the curve of the spring should be adjusted to the configuration of the wearer, as far as practicable, it should lie above the region of the glutei muscles; otherwise, their action in locomotion produces a constant motion of the pad.

Trusses may be divided into two general classes: the French, and German or English. The former has a very light, but highly elastic spring, clinging closely to the body and following up the retreating parts in every motion. By it, constant pressure is preserved. On the contrary, the German form is a much heavier spring, shaped so as to conform to the outline of the body, is by so much inelastic and less comfortable. It resists, on this account, with great power any strain brought to bear upon the parts in contraction, but presses only lightly, or not at all, when the body is at rest. American ingenuity has found a fertile field in truss making, which of itself would make a chapter of interest. The small hard pad of wood, or ivory, with a spring constructed so as to carry the supporting force obliquely upwards in the direction of the canal (the White truss), often serves a valuable purpose. This is a modification of the wood pad first devised and sold, about 1835, as the Stagner truss. These

were greatly improved by Dr. Chase* and others. The water pad, invented by Dr. Nathaniel Greene, of Boston, rubber filled with water, is also a valuable contribution to both comfort and convenience. Where a light pressure only is required, it is often of the highest value. Since we shall not again return to the subject of supports, it may be added that the femoral hernia requires an instrument adapted to make the support quite lower than in inguinal hernia. In large irreducible hernia, special supporting and constricting bags, lacing or otherwise, have been devised, and, when for any reason operative measures are not advised, should always be carefully applied. Umbilical trusses are made also in considerable variety, but in all, the one general object is to obtain a support, to prevent the escape of the hernia or, where this is impossible, to retain from greater enlargment.

*Treatise on the Radical Cure of Hernia by Instruments, by Heber Chase, M. D., Phil. 1836.

CHAPTER V.

IRREDUCIBLE AND STRANGULATED HERNIA.

IRREDUCIBLE HERNIA.

Quite a variety of causes produce this condition. Usually the history is given of a hernia which has existed for years, often not supported even by a truss, or one that fitted improperly and had been discarded. More commonly, the omentum is the first troublesome factor, adhesions between it and the walls of the sac, and this again to the contiguous parts prevent return; as the opening shortens and enlarges, a loop of intestine becomes a factor, and gaseous or fæcal distension causes a further yielding of the weakened parts; often symptoms of obstruction, pain, constitutional disturbance, slight elevation of temperature, nausea, followed by vomiting, are the premonitory symptoms of danger which precede actual strangulation. Not seldom, although the tumor cannot be reduced, a careful manipulation may remove the temporary obstruction, the gaseous distension be overcome, and the intestinal canal resume its function. The general history of such cases is that of invalidism, steadily growing more pronounced. Often rest in the recumbent position for some days, the hips higher than the shoulders, and the parts supported, hot applications locally, light diet, opiates, enemata, etc., are demanded. In this

way relief is obtained without manipulation or taxis, and when these measures are resorted to they should be conducted with the greatest care. The size of the irreducible hernia is sometimes enormous. Often when the patient is about, the scrotal tumor becomes a deformity difficult to conceal. Birkett reports the following: "The largest double rupture I have seen was in a bricklayer, fifty-five years old, whose bodily health, strength, and conformation were in other respects good. The left hernial tumor was the largest, although it had only existed about three years, whilst the right had been there twelve years. The lowest body of the tumor very nearly reached to a level with the patellæ. Its circumference in its largest part measured thirty inches."*

Besides the inconvenience of such tumors and their attendant suffering, the patient runs many dangers. The greatest is strangulation of the incarcerated intestine, although this is probably less than in reducible hernia, since the sac is nearly full and the less readily admits of a sudden increase of contents. Injuries are common from accidents.

Cooper relates a case where death occurred in a few hours, after a fall, from rupture of a portion of the ilium. He also quotes a case from Mr. Norris, a contemporary surgeon, who showed him the specimen.

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* Holmes' System of Surgery.

"Whilst running, and suddenly turning the corner of a street, he struck violently against a post. The middle of the abdomen was the part that received the shock, from the effects of which he soon appeared to have recovered, but on proceeding a little way he felt great pain in the belly, and became very faint, which obliged him to sit down on the steps of a door. In about ten minutes he was just enough recovered to be able to crawl to his home, which was about two hundred yards off. I saw him on the following morning. There was not the slightest appearance of injury on the part that had received the stroke, but on the course of the spermatic process on the left side extending into the abdomen, there was a fullness and enlargement equal to a moderate sized hernia. He vomited quite frequently, his pulse was quick and extremely feeble, his countenance was pale and expressive of the greatest anxiety, and he complained of acute pain all over his belly. The abdomen, however, was quite soft, and the contents of the tumor were easily returned into its cavity, but quickly came down again when the pressure was removed. These symptoms continued with the most torturing pain till the evening, when he expired. Having obtained leave to open the body, Dr. Telloly and myself met the day after his death for that purpose. The tumor was now larger than before, discolored, and contained air, discoverable to the touch. The contents of the tumor were found, on opening it, to be air, blood, and water.

On examining the abdomen a similar fluid, to the quantity of a quart, was found effused. An irregular aperture was perceived in the ilium, which readily admitted my finger, and through which everything that had descended into the stomach found a ready passage into the cavity of the belly. No other injury of any kind to any of the contents of the abdomen could be detected." *

Foreign bodies introduced into the stomach may be caught and retained in the intestinal hernial loop and serious trouble arise therefrom. Cooper relates a case of a boy aged thirteen sent to hospital where a quantity of fœculent matter was constantly passing from an irreducible scrotal hernia. Five weeks before, he had accidentally swallowed a pin. This was withdrawn from the scrotal opening, but after a variety of efforts to cure, he was discharged with the fistula still open. The case of Mr. Gibbon, the celebrated historian, is given by Sir Astley Cooper as an illustration of possible danger. Its interest is quite sufficient for giving entire.

"Mr. Gibbon had been for thirty years subject to a scrotal hernia on the left side, of which he made no complaint, and to which he applied no remedy to prevent its increase. But in the summer of 1793, finding it grew suddenly uneasy he became alarmed, and consulted Sir Walter Farquhar and Mr. Cline.

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* Sir Astley Cooper.

The tumor was then of uncommon size, reaching to his knees, and very large at its connexion with the abdomen. As some water was perceptible at the lower part of the tumor, it was tapped in the month of November, 1793, and a large quantity of water was drawn off. In a fortnight after, it was again tapped and three quarts of water were evacuated without any sensible diminution of the swelling. Six weeks afterwards, the skin over the tumor having inflamed and shown a disposition to ulcerate, the tapping was again repeated, Jan. 13, 1794, when six quarts of water were discharged. Two evenings afterwards he began to complain of a pain in his stomach and soreness in the abdomen, and in the tumor on pressure. He passed the night restlessly, but the next morning when he rose he seemed in better health and spirits than usual. Soon after he became insensible, and expired about eleven o'clock.

Mr. Cline asked me to accompany him to inspect the body. We found the abdomen nearly emptied of all the moveable viscera, no omentum remaining within its cavity, and of the intestines only the duodenum and cœcum. Even the pylorus was drawn down so low as to lie upon the orifice of the hernial sac, into which all the omentum, and all the intestines, except those I have just mentioned, had descended. They were all uncommonly loaded with fat, and slightly inflamed. The hernial sac extended nearly as low as the knee, its orifice was so large as to admit my hand

within it. Below the sac appeared a separate bag large enough to hold several quarts of water, which, by its containing the testicle, proved to be the tunica vaginalis testis."

The practical questions arising from the consideration of irreducible hernia are those of treatment. Often it is exceedingly difficult to determine the exact conditions of contents. If omental only, a truss may be fitted, if intestinal, the pressure of a truss would prove dangerous. A small loop of intestine may be concealed in omentum and not easily detected. If the truss proves painful, it should be worn with great caution, or better omitted entirely. When a hernia becomes irreducible, it is almost certain to grow worse steadily and endanger the life of the sufferer constantly. Modern aseptic surgery should relegate the entire class, almost without exception, to operative measures.

STRANGULATED HERNIA.

When the constriction of any portion of the contents of the hernial tumor is sufficient to impede or impair the circulation of the blood and thus endanger the nutrition of the parts enclosed; to arrest the passage of the fœcal contents through the intestinal canal, the hernia is called strangulated. Constitutional symptoms speedily supervene and unless relief is afforded the condition is one of extreme danger.

The neck of the sac is usually the seat of the con-

striction. It may, however, occur in any portion and there may be more than one constricting band. The causes of strangulation are various. Obstruction may, and, very likely, does frequently supervene upon changes in the circulation and nutrition of the intestinal loop within the sac. The venous return current impeded; there will ensue, even in an old hernia, an increased weight, a suspension of peristaltic motion, a retention of intestinal contents, resulting in an overdistention of the sac. It is probable that, in most instances, the changes commence within the sac, rather than in the constricting part. Once commenced, however, they mutually react to the injury of both.

As generally observed, the first symptoms are local pain, a tumor more or less large, if none existed before; if an old hernia, a tenderness and increase of swelling, a dragging weight, and a sensation of uneasiness in the hypogastrium. This, sometimes, becomes so severe that it seems as if a cord was tied about the body. The mechanical obstruction to the intestine is soon followed by more marked nervous symptoms, pain and restlessness supervene with nausea and vomiting; this may be accompanied by a desire to defecate, and straining at stool results in the passage of little except flatus. Sometimes these general reflex nervous symptoms are so prominent that the patient and physician both may fail to consider the cause as one of obstruction or think of hernia.

If unrelieved, the general symptoms become more marked, the nervous anxiety pronounced, the pulse small, hard, quick, the temperature somewhat elevated, and the nausea and vomiting severe. There is a gaseous distension of the intestines, giving a tense, tympanitic abdomen. The vomiting becomes fæcal and no gas passes the anus.

When these symptoms have become marked the obstruction is not only complete, but has existed longer than is consistent with safety. Every practitioner should study the grouping of such symptoms and be early on the alert, since danger increases each hour, almost in a geometric ratio. The intestinal canal, between the obstruction and the stomach, not seldom the stomach even, becomes, by degrees, distended with a dark brown colored fluid; this rapidly undergoes fermentation and sets free gas which greatly adds to the stretching of the intestine, causing a paralysis which is often slow in recovering. The mucous membrane is deeply congested, the villi turgid and swollen, even the serous coat much changed in color, and is often punctated or striated in patches of deep red. The intestine, on the contrary, below the stricture is decidedly pale and contains little except mucus.

If the patient remains unrelieved, uncontrollable retching and vomiting may ensue, prostration supervenes rapidly, and death from collapse may occur. Life may be prolonged until the constricted portion of the intestine ulcerates and the intestinal contents set up a rapid septic peritonitis.

At the beginning stage of prostration, the active nervous tension abates, the nausea, especially if the patient is partially narcotized, lessens or disappears. This should not quiet the attendants, but, on the contrary, betokens grave changes, a depression of the vital force, from which the patient never rallies. The pulse, before full and rapid, is now slower and weak, the heart contracting with little force. The cutaneous surface is cooled and shrivelled, the hands and feet cold and wet; the expression is one of anxiety and distress, the tongue dry and brown. The muscular system is relaxed and the urinary secretion is greatly diminished.

The patient may continue for some time in this state—the very threshhold of death, pulseless, scarcely seeming to breathe, yet with unclouded mental vision and able to converse, a slight change only, and death has supervened.

When death follows, the local conditions do not present changes sufficiently marked to have caused such a result, and the fatal issue is very probably dependent upon the extreme nervous exhaustion, or collapse.

Although local pain is considered a sign of peritonitis, it is difficult to determine the inception of the peritoneal inflammation. It is often local with a protective layer of lymph effused. When arising from perforation, the pain is usually severe, and death may follow from the shock to the nervous system, but usually from rapid infiltration, as a septic poisoning.

The pathological changes of the contents of the intestine are of interest. The vomitus, at first, appears to consist chiefly of the ingesta, frequently of the substances last taken into the stomach. Then the fluids become changed in color, odor, and taste, by being mingled with the biliary secretions. The color changes from greenish hue to brown or even almost black, and later the odor becomes feculent; the well-known stercoraceous vomitus.

Blood cells may often be found and the color of the serous fluid is deepened by that of the blood. Epithelium is constant, often in patches, and the quantity of fluid in the intestine and stomach, owing to the impaired venous return current, is often quite beyond expectation. In a case of operation for vulvulus, where I easily freed the intestine and had closed the wound, as the ether was removed, a spasmodic continued vomiting ensued, and death occurred from impeded respiration, although the head was carried forwards with tongue drawn out and every effort made to clear the throat. It was estimated the ejected fluid exceeded two quarts.

There is usually a limited quantity of serum in the sac of a strangulated hernia. This varies according to the character and duration of the constriction.

At first it is pale yellow, clear serum, changes in color, and later becomes turbid, with blood cells freely mingled, even to the production of small clots; the serum may then become like dark coffee. Not seldom,

there is to it an odor like feces and it would be interesting to know, if the fluid is not infected with bacteria from the intestinal contents, escaped through the imprisoned walls. It is probable that micrococci are in abundance.

The tissues, covering the tumor, exhibit changes coincident with those of the contents. These are more marked nearest the constriction and lessen towards the surface. Violent manipulation of the mass may and often does cause marked changes in the integuments; echymosis of the connective tissue, œdema, and redness of the skin.

In strangulated omental hernia, the symptoms are much less severe. The pain is often inconsiderable, the vomiting not marked, and the abdominal distention not pronounced. The intestinal function, although generally inpaired, is not suspended and passages from the bowel are obtained with greater or less difficulty. When fatal, death occurs from necrosis of the part with subsequent general infection.

The danger from strangulation is greater in femoral than other varieties, since the constricting ring is less yielding, and the canal generally smaller. Small recent hernia are also more liable to strangulation and more easily overlooked.

A variety called bubonocele, where the hernial tumor is retained within the canal, is often so small as to escape detection unless specially sought and may be, on this account, all the more dangerous.

Dr. A. H. Wilson,* of Boston, has contributed a valuable paper upon the subject. He narrates a case where death ensued from a concealed hernia of this character, not recognized until at autopsy. The possibility of obstruction arising from this cause should be held in consideration.

Strangulated hernia, unless the tumor is reduced, is almost always fatal. In some instances, the wall of the intestine becomes adherent, a small slough occurs, leaving an ulcerated opening through which a small portion of the fecal matter escapes, the larger part running its natural passage. In other instances, the incarcerated loop sloughs, and an artifical anus is formed, through which all the fecal material passes. Such complication may result in hernia of the rarer varieties. Somewhat recently a patient entered hospital, with constantly recurring fecal dejections escaping through the vagina. About two weeks previous she had been delivered with great difficulty of a child, at term, with a shoulder presentation. It was not recognized that the vagina had been injured until symptoms of obstruction supervened. After some days, fecal dejections came from the vagina. A loop of the ilium had escaped through a vaginal rent, become adherent, and sloughed. As death seemed imminent from starvation, after consultation, an attempt was made at restoration by laparotomy. The general

* Journal of the American Medical Association, Aug. 25, 1883.

peritoneum was not involved, the intestine was freed from its attachment and withdrawn. The ulceration included about three-fourths of the circumference. The edges were refreshed and reunited. Unfortunately, however, the patient sank and died from exhaustion the second day.

The prognosis of strangulated hernia must be determined, from the foregoing considerations, to be of a gravity dependent upon the character of the constriction and the time since it first ensued. It may be accepted that there are few dangers to which the race is liable that become so fearfully aggravated by delay.

CHAPTER VI.

SURGICAL PROCEDURES.

Operative Measures.—The dangers from the proper performance of the operation for strangulation are in direct ratio to the above factors. "We have never known an instance of a patient dying in consequence of the bowel being liberated at too early a period; but we have had to operate upon many whose chances of life were absolutely sacrificed by the inexcusable delay which had occurred before the patient was submitted to the operation. We make this assertion after a large experience, extending over many years."* The statement of this eminent surgeon is in accord with the experience of most operators. It is now generally conceded that the danger lies not in the operation, but in the conditions which demand it. It may be accepted that, with aseptic precautions, the operation is practically safe. In an experience of twenty years, I am assured I have not had a single fatal case where the integrity of the intestinal canal was not involved. I have repeatedly removed large portions of the omentum without complication.

In this respect, hospital statistics as such are of little value. The cases are sent in late, often have been sadly neglected, and their condition rendered

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* Birkett. Opp. cit.

much worse by injudicious, and even violent attempts at reduction.

The attendant is, at first, in the great majority of cases, a physician little experienced in operative measures and much valuable time is lost in "watching the case," the administration of drugs and leading up, not only the friends, but himself to the conclusion that the case is involved in serious danger.

What should justly precede operative measures is a question of important consideration.

First, the careful differentiation of the factors in the problem presented. This will notably consist of a consideration of the character of the hernia in its anatomical relations—its kind and variety; its formation and duration; the constitutional condition, the state of the tumor, the treatment already employed.

The dextrous manipulation of a hernial tumor, by which it may be displaced from its abnormal surroundings, and restored to a normal condition, is termed *taxis*. It seems almost universally accepted that this is a simple measure and should be resorted to without fear. Generally, when the physician is called, it is only after constitutional symptoms of some gravity have supervened and, almost always, efforts, more or less persistent, have been made at reduction. Often vomiting is persistent and the tumor is swollen and tender. If this is the condition, taxis at first should not be attempted. Place the patient in a position to relax the muscles; on back, pelvis elevated, knees

flexed and tumor lifted so as to relieve the dragging on the neck of the sac and aid displacement by gravity. Hot applications are sometimes of value; if the skin is red and tense, ice may be kept on often to great advantage and the general condition improved by hypodermic injection of morphia. Happily, a few hours sleep and the hernia is, so to speak, self reduced. If continued, use very gentle manipulation and if this fail, no longer delay to be prepared for surgical interference. Thus ready, thoroughly anæsthetise your patient. This is of the first importance in the proper use of taxis, since it canses a relaxation of the tissues obtainable in no other way, and enables the operator to avail himself of every possible advantage of position, of both the tumor and the surrounding parts. With much tact and care, gently endeavor to reduce the tumor, remembering that a constricted intestine, after twenty-four hours, may be easily lacerated. If, for any reason, from the use of taxis, or violence of accidental character, it is feared that injury to the sac, or its contents has ensued, let operative measures be at once undertaken. Upon opening the sac, if the intestine is so discolored as to cause it doubtful if necrosis has not already taken place, pull down the loop beyond the line of constriction, after the opening has been made sufficiently large, and carefully observe if the circulation is slowly restored. This assured, it is safe to return it and close the wound. If the intestine is injured, so that its integrity is in part,

or entirely destroyed, then give your patient the advantages which modern surgery has so marvelously wrought in the treatment of wounds of the intestine. The omentum, as well as the intestine, often suffers injury in efforts at reduction, or by violence. This, of course, is less important, but not rarely will it become wise to remove the enclosed portion, as a measure much safer than to venture its return. I have often done this with seeming impunity, certainly without complication or danger.

The hernial sac may suffer from violence, either in being torn from its attachments and the tumor with its peritoneal investment returned en mass, or the sac itself may be ruptured under pressure, and the contents still further displaced into the subjacent parts.

In the first instance, it is very probable that the constriction of the neck of the sac will still continue to surround and incarcerate the contents. Such cases are undoubtedly very rare, yet sufficiently numerous in the history of surgery to render the study of such conditions interesting. They will be less often met with hereafter, since the teachings of modern surgery cause operative measures to be less feared and consequently efforts at taxis will not be as persistent. If there is evidence that such a complication has resulted, operative measures should be at once undertaken, and even laparotomy may be a measure to be wisely considered.

When the sac has been ruptured and its contents

in part displaced, it may be difficult to determine the exact condition, especially if the surgeon has not previously seen the patient. The sac will be noticeably less tense and the feel of resistance less, but the all-important symptoms of obstruction remain, and when this is the case, operation must not be delayed. It may even, after the sac has been opened, be at times difficult to determine the exact relations of the parts, but these must be carefully differentiated, since life itself will depend upon a proper restoration to the normal condition. Divide freely, pull down the intestine and ascertain the exact point of exit point from the abdominal cavity; thus the opening or neck of the sac is determined, and then there will be little further difficulty in enlarging it and restoring the intestinal contents. This done, as before recommended, dissect out the sac entire; often certain portions of the surrounding tissues have also been so much injured as to involve their integrity, and these also should be cut away.

Somewhat recently, I operated upon a strangulated hernia of three days' duration. The intestine, fortunately, was surrounded by omentum. and its integrity not destroyed, but prolonged taxis, the day previous to operation, had resulted in not only marked injury to the sac, but the tissues, for a considerable distance, were echymosed and so devitalized that the dissection was carried several lines outside the sac and removed together with a considerable piece of

omentum. Recovery was rapid, and the cure at time of writing remains complete.

In the chapter upon the formation of the peritoneal sac, it was shown that it may rarely be double or mutiple, and this complication should be borne in mind in the reduction of a hernial tumor. The contents may pass a stricture and enter the abdominal parietes, only to remain still without the abdominal cavity, the upper portion of the sac remaining as a pouch with constriction at its inner orifice. Symptoms of obstruction will continue, and these should determine upon operative procedures.

In all the foregoing conditions, there can be but one rule—never assume, but determine upon positive knowledge the actual conditions. When in doubt, consider it as a sacred duty you owe your patient to give him the benefit of it, and if solved in no other way, by resorting to operative interference.

For a long period the profession generally have held that the operation of cutting is one of such serious moment that it should be undertaken only as a last resort. This belief seems to have arisen from the wretched results which have followed the generally delayed operation. Certainly, it is not the teaching of the early masters.

Sir Astley Cooper recognized, even in his day, when the lack of anæsthetics and of the requisite knowledge of proper wound treatment rendered the operation truly formidable, the fatal error of delay.

"The operation, if well performed in an otherwise healthy person, is attended with little, if any, danger, and it is therefore natural to inquire why it has so frequently been followed with the death of the patient. The great reason of want of success in this operation is its being performed too late, so that the protruded contents have proceeded to a state of gangrene, or so nearly approaching to the gangrenous condition, that the long inflammed parts are unable to recover their natural functions; or else that the inflammation has extended to the viscera in the cavity of the abdomen, continuing the consequence of the disease after the stricture which caused it has been removed. It cannot be too much lamented or condemned, that so much time is commonly lost before the operation is performed. To reduce the hernia, trial after trial is made, the same means are often repeated, the tumor, by being often compressed, becomes excessively tender, so that the mere cessation of the efforts at reduction gives a comparative ease, which flatters the patient and his medical attendant that a part of the tumor has gone up; hopes are still entertained that an operation may be avoided, till the rapid progress of the symptoms of danger points out the fatal error of delay, and when the operation is performed, too clearly demonstrates the impossibility of success."*

What more graphic picture could be drawn to-

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* Op. cit.

day of the fatal errors of delay than by this great master of nearly a century ago! The sooner this error is eradicated from the medical thought, the better. Then shall we discover upon what fallacies we have founded our opinions! If I write for no other good than to bring the question of operative measures anew under a discriminating judgment, I shall not have labored in vain. When the errors of omission are judged equal to those of commission, then the serious responsibility of the advisor will be viewed in a new but just light.

HERNIOTOMY.

There may arise occasions where the necessity of operative intereference permits only a very limited preparation. Under these conditions, the operation may be successful by the use of only knife and director, or even without this latter instrument. However, it is always far better to have trained assistants, if possible, and to make provisions for contingencies.

The instruments required are an ordinary scalpel, grooved director, several pairs of forceps, including dissection, artery, and tenaculum forceps; a bistoury with blunt point, commonly called a hernia knife, that devised by Sir Astley Cooper is still a favorite; needles and reliable catgut or tendon.

The patient when fully under the influence of an anæsthetic is placed upon a table in a good light.

The head is slightly elevated, the legs nearly paralle with the body and the feet in a chair. An inflated rubber receptacle is placed under the hips to conduct the irrigating fluid into a pail. The bladder is emptied and the parts carefully shaved and cleansed with a solution of $\frac{1}{1000}$ mercuric bichloride.

Commencing at the upper part of the external abdominal ring, extend the incision downwards over the tumor quite to its base unless very large. It is better not to try to differentiate the layers composing the coverings of the sac, since they are often much changed and will be quite sure to confuse, rather than aid the inexperienced.

Divide the fascia upon a director, or lifted by forceps, with care; the only sure anatomical guide in the male will be the fibres of the cremaster, but these are of little importance. When the sac is exposed, by grasping the tumor posteriorly, fluid is generally perceived distending it under the line of dissection. Also, when pinched between the thumb and finger, the surfaces of the sac may be made to glide upon each other; generally there is not much difficulty in determining the sac. Through a small opening made in it, insert the director, and divide freely downwards, and upwards to the external ring. In small inguinal herniæ, the incision should be made parallel with Poupart's ligament, from the internal to below the external ring; in femoral herniæ, on the inner side or over the crural ring, usually in a vertical direction.

The sac in recent herniæ, is vascular and of a bluish-white glistening color; in old herniæ, it is often thick and opaque. After snipping the sac, the division is first made from above downwards, since the base of the sac is usually partly filled with serum, more or less changed, which serves as a protection to the intestine. The finger is introduced into the sac and carried gently to the ring. The exact diagnosis of the conditions can now be made, as well as correct knowledge of contents. The obstruction is usually found at the upper border of the sac near the internal ring. The finger is generally the only director required and by far the best, since it teaches the constriction, its characteristics as to firmness, extent of thick ness and often the location of the neighboring arteries. The probe-pointed bistoury is carried on the finger flatwise through the stricture, which is divided by turning the edge of the knife against it. I have often been surprised to note how little of the firm tense band it is necessary to divide. Usually a few fibres yield with a peculiar grating sound; an incision only a line or two in depth is required and the constriction is freed. Emphasis has been made very properly upon the possibilities of cutting the epigastric artery, but I cannot help feeling that this danger is greatly overestimated. Fortunately, I have never seen it injured; but should this happen, it is not a very important vessel and can be easily secured. The old rule, based upon very many special dissec-

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tions, is a wise one, to cut directly upwards, since, in an oblique inguinal hernia, the artery is internal to the neck of the sac, in direct, external and at times the canal is so much altered that it may be difficult to determine the relation. Various modifications of sheathed, narrow, cutting instruments have been recommended as improvements upon the herniotomes. A very ingenious hernia knife has been devised by Dr. Allis, of Philadelphia. It is probe-shaped, with a moveable sheath, directed by a nut, to conceal or expose the cutting edge as desired. The best which I have seen is one by Dr. Joseph H. Warren, of Boston, which combines the director and divider in a single instrument. By pushing a thumb-screw in the handle, a fine saw is carried through the groove and the stricture sundered in a very safe manner. Having freed the constriction, the contents of the sac are carefully examined. If lymph has been effused, and adhesion formed, separate gently and wash carefully in the warm sublimate, before returning the intestine into the abdominal cavity; examine as to the returning circulation in the bowel, integrity, etc. If omentum also makes up a part of the contents, gently unfold its compressed layers; if its integrity is at all doubtful, remove after having sutured across above the line of division. Thus secured, I have never seen trouble from hemorrhage. It is so vascular that ligation of the many bleeding points may be very troublesome.

Having returned the abdominal contents, the

subsequent treatment of the wound is to be conducted upon precisely the same conditions as if the operation had been undertaken to cure a non-strangulated reducible hernia. The factors of cure for every reason, however, are less favorable, since the general and local conditions are often of the gravest character.

Until the introduction and establishment of modern wound treatment, upon a basis of true science, the surgical treatment of hernia was a problem little if any modified or improved by the experience of a century. The dread of inflammation and the terrible results supervening, when its locality was within the abdomen, gave to the name of peritonitis a signification of fear unknown to the younger members of the profession of to-day. Since the teachings of Mr. Lister, and the now well formulated facts of wound infection, the revolutionizing of surgery is nearly complete. In no operation is an aseptic condition of the wound more important than in hernia; it is to be considered as a modified laparotomy, which involves always the possibility of a peritoneal infection. In Mr. Birkett's masterly article upon hernia, in Holmes' Revised System of Surgery, published in 1881, the treatment of the wound, after operation for strangulation, is dismissed as follows: "The structures which have been cut and disturbed by the cutting operation should be placed in relation to each other, and the divided edges of the integuments brought together by sutures. The number required may be left to the discretion of the

operator, but no more need be used than sufficient to keep the upper two-thirds of the wound united. For it is always advantageous to leave an opening at the lowest end to allow of the escape of the blood and discharges. A piece of wetted or dry lint may be placed over the incision, and a pad of folded lint is adjusted over it by some surgeons. However, a bandage is not required in every case, nor is it, on any account, essential."

Warren, writing in 1882, states: "The wound is now drawn together by sutures and the dressing completed by adhesive plaster, compress, and a spica bandage. Morphine or opium should be administered, both to secure rest and also to secure the patient against that inflammation, always to be dreaded, 'peritonitis.'"

In 1884, Mr. John Wood writes: "The edges of the wound are then brought together with sutures, sufficiently close, a drainage tube being placed along the bottom and out at the lower end of the wound, and the parts dressed and well padded with carbolized gauze, tow, or cotton wool, the whole secured with a spica bandage and a support to the scrotum, * * * In favorable cases, with little damage to the hernial contents, I have for many years been in the habit, at the end of the operation for the relief of strangulation, both in inguinal and crural hernia, of taking away the

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*Vol. II, American edition, p. 707.

sac, after tying it with catgut, and closing the tendinous hernial opening by my wire operation, and with the best results, both without and with the spray and gauze treatment."

These quotations from the leading special authors upon hernia, who have written within the very late years, may be accepted as the expression of the general practice of to-day. Many other more recent authors might be cited who repeat similar instructions, but these teachers have devoted many years of careful investigation to the subject and yet they wrote as above, long after the establishment of antiseptic wound treatment.

TREATMENT OF THE WOUND AFTER REDUCTION OF THE STRANGULATED PARTS.

With one or two fingers of the left hand, inserted into the base of the sac, carefully separate it from its adhesions to the surrounding parts, quite to the internal ring. Having thus freed the sac, quite within the internal ring it should be drawn gently but firmly downward and put on tension by an assistant. It is then sewed across its neck, in even continuous double suture, with tendon, and excised. The peritoneum is gently pushed within the

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* J. H. Warren, Boston, 2nd Edition, p. 219.

† J. Wood, Vol. V. International Encyclopedia of Surgery, page 1135.

internal ring, and the latter is slightly refreshed with the edge of the bistoury. The lower and inner border of the ring is transfixed by a needle, with eye near the point, armed with tendon.

FIG. 7.

Dr. Marcy's Needle, used in the application of the deep double continuous animal suture. The eye is large and smooth, and there extends in both directions a slot to catch and hold the thread from slipping. The point and inner side is rounded to prevent cutting of the tissues.

It is guided upon the index finger of the left hand, which is retained in the ring. The needle is unthreaded, threaded with the opposite end of the suture and withdrawn. Stitches are repeated, about one-third of an inch apart, in this way, and the inguinal ring, thus obliquely closed, is reformed, but not shortened, narrowing down upon the cord, in the male, as closely as deemed safe, and not impair its integrity. Throughout, it is protected by the finger, during the application of the sutures.

A second and more superficial layer of sutures is made, in the same manner, through the fascia, the last stitch knotted, and cut close. The skin is co-

apted also by a buried suture. This is best effected by the use of a straight, or slightly curved Hagerdorn needle, carried from within, through the deeper layer of the skin, from side to side. Thus the edges of the skin are evenly co-apted without the vestige of a stitch in sight. The surfaces are carefully dried and dusted with iodoform. Iodoform collodion is freely applied, into which are incorporated shreds of cotton. The operation is conducted under irrigation with the greatest care to preserve the wound in an aseptic condition. This assured, drainage is not necessary. In my earlier operations, I reduced the drainage to the minimum, by the introduction of a few parallel placed horse-hairs. Even these, however, I have omitted for some years. Coapted surfaces, held aseptically at rest, readily tolerate the limited effusion which is utilized in the processes of local repair. The elimination of the drainage tube renders the complete closure of an aseptic wound possible, and prevents its further extraneous contamination. Repair ensues as in a subcutaneous wound. The advantage of this method in the treatment of the wound is the assurance of non-infection. By every method of antiseptic dressing with drainage, all surgeons have admitted the great difficulty and, in children, the well-nigh impossibility of retaining the wound aseptic.

The advantages of resection of the sac, as compared with other methods of its disposition will be discussed in a subsequent chapter.

In congenital hernia, it must be remembered, that the sac is the dilated, non-closed process of the peritoneum which descended to form the investment of the testicle. Under these conditions, the sac requires different treatment. It is sewed across to form the tunica vaginalis testis. The suturing is continued upwards to close in upon the cord with its vessels, and then narrowed at its abdominal outlet, to prevent pouching of redundant peritoneum and excised. The subsequent steps of the operation are conducted as in non-congenital hernia.

CHAPTER VII.

FEMORAL HERNIA.

The superficial fascia of the thigh is composed of two layers. The thick, dense, upper layer is continuous with the fascia above, over Poupart's ligament, and downwards with the connective tissue layer covering the thigh. Enclosed between it and the deep layer, are situated the cutaneous vessels, nerves, and the lymphatic inguinal glands. The deep layer is a thin, but dense membrane, is closely adherent above to the lower margin of Poupart's ligament, and about one inch below is closely united, in its circumference, to the saphenous opening in the fascia lata. It blends with the posterior border of the sheath of the femoral vessels. In this locality, it has been sometimes described as the cribriform fascia, since it is perforated by the internal saphenous vein and numerous blood-vessels and lymphatics, giving to it sieve-like openings.

The fascia lata, in a dense, connective tissue layer, forms a uniform investment over the entire upper portion of the thigh. The passage of the internal saphenous vein gives the name to the opening through which this vessel penetrates. The fascia, on the outer side of the opening, is called the *iliac* portion. It extends from the anterior superior spine of the ilium downward, over the anterior group of the

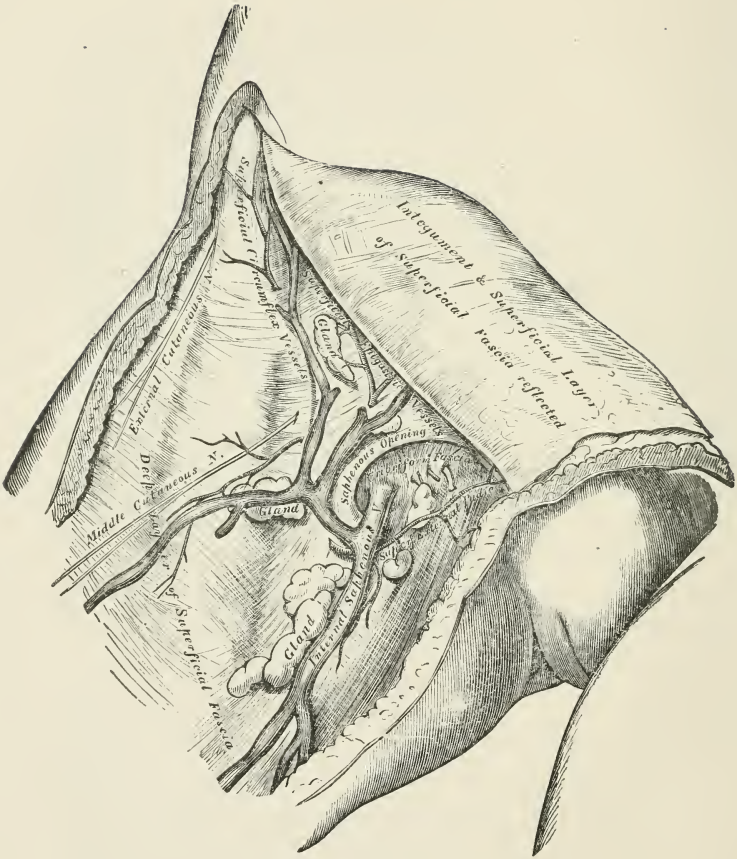

FIG. 8.

Femoral Hernia, Superficial Dissection.—GRAY.

muscles of the thigh; is attached the whole length of Poupart's ligament internally, as far as the spine of the pubes, and joins in the pectineal line with Gimbernat's ligament, where it blends with the pubic portion. It is reflected in an arched margin downwards and outwards from the spine of the pubes, forming the outer boundary of the saphenous opening. This has been described as the femoral ligament of Hey, and has also been called the falciform process of the fascia lata. It has a well-defined, curved margin and is adherent to the sheath of the femoral vessels. The *pubic* portion of the fascia lata is its continuation upon the inner side of the saphenous opening, and lies beneath the sheath of the vessels to which it is attached. The opening, through which the internal saphenous vein thus obliquely passes to join the femoral, is oval, measures about an inch and a half in length, and half an inch in breadth. The inner boundary is less well-defined than the outer, since it is behind the level of the femoral vessels.

Upon extension of the limb, or rotating it outwards, the edge of the opening will be rendered tense. Flexion and inversion of the limb relaxes it, a fact to be borne in mind when attempting the reduction of a femoral hernia.

In the study of inguinal hernia, Poupart's ligament was described as the lower border of the aponeurosis of the external oblique muscle, stretching across, in a strong, tendinous band, between the an-

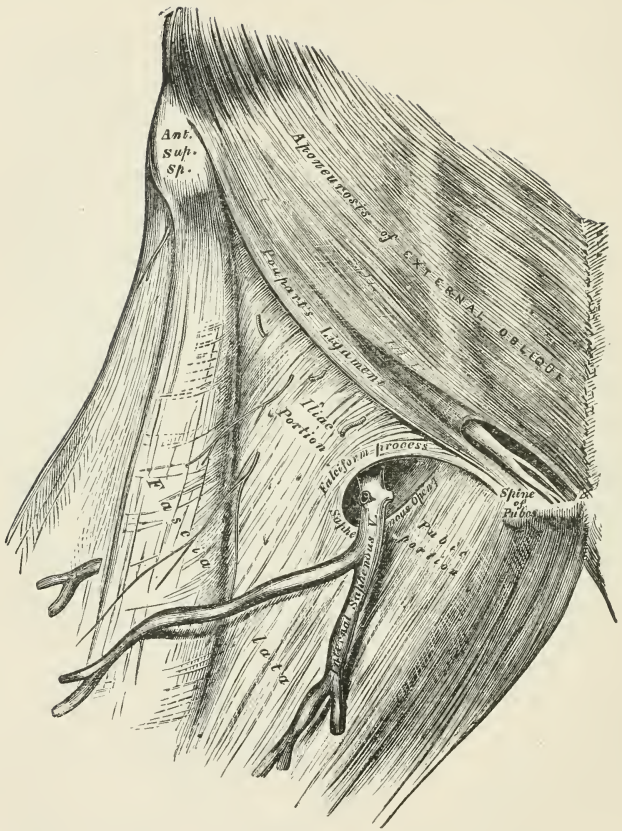

FIG. 9.

Femoral Hernia, showing Fascia Lata and Saphenous Opening —GRAY.

terior superior spine of the ilium, to the spine of the os pubis and the pectineal line It is slightly curved, with convexity downwards. The posterior border has an arched form towards the pubes, in consequence of the expanded portion which is fixed into the pectineal line. This was called the crural arch by Gimbernat. We are indebted to this distinguished Spanish surgeon for the first accurate description of the parts, published in Madrid, in 1793. The attachment into the pectineal line, which so greatly strengthens the support of the external oblique, is now generally called Gimbernat's ligament. The space between the crural arch and the bone is almost entirely occupied by the parts which descend from the abdomen. On the outer side are the psoas and iliac muscles. On the inner side, are the femoral vessels inclosed in a sheath. The oval-shaped opening, for the passage of the vessels, is the crural, or femoral canal. Through this opening, the abdominal contents escape in femoral hernia. The upper border of the canal is called the femoral ring, and is continuous with the cavity of the abdomen. It is larger in the female than in the male, (a possible reason for hernia being more common in women) and, in its large, transverse diameter, measures about one-half an inch. In front, it is bounded by the deep crural arch of Poupart's ligament, behind by the pubes and the deep portion of the fascia lata, internally by Gimbernat's ligament, the conjoined tendon, the transversalis fascia, and the deep crural arch;

externally, by the femoral vessels enclosed in their sheath. Poupart's ligament separates the femoral from the internal portion of the inguinal canal; directly above it, lies the spermatic cord, with its vessels, in the male, and this may be divided in the operation for strangulated femoral hernia. The epigastric artery lies across the upper and outer angle of the ring, and is endangered by cutting in this direction. Upon the outer side of the ring is the femoral vein. The ring is, as it were, bounded in all directions by vessels, except posteriorly by the ossa pubis, and internally by Gimbernat's ligament.

The obturator artery holds an important relation to the femoral ring, when it arises, by a common trunk, with the epigastric artery. This is the more important, since this is the condition in every three or four individuals. Occasionally, the vessel curves along the margin of Gimbernat's ligament as it passes to the obturator foramen and, when this occurs, it is very likely to be divided in the operation for a strangulated femoral hernia.

A delicate layer of connective tissue closes the femoral ring, and is described by M. Cloquet as the septum crurale. It is a slight protection to a hernial protrusion; a small, lymphatic gland usually lies between it and the peritoneum. It is perforated by numerous, small openings for the passage of lymphatic vessels and serves as much for their connection and support, as for closure of the ring. Beneath this sep-

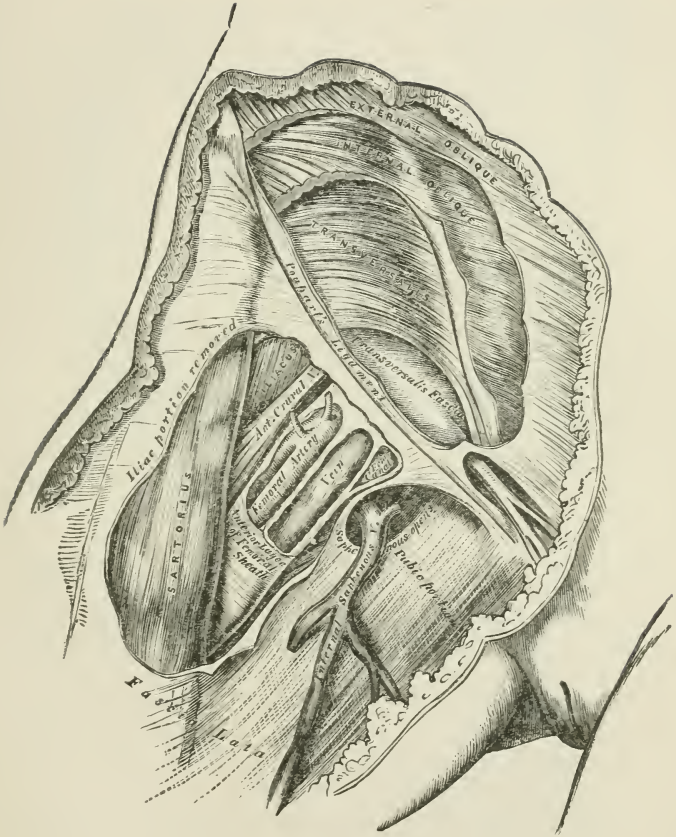

FIG. 10.

Femoral Hernia. Iliac Portion of Fascia Lata Removed, and Sheath of Femoral Vessels and Femoral Canal Exposed.—GRAY.

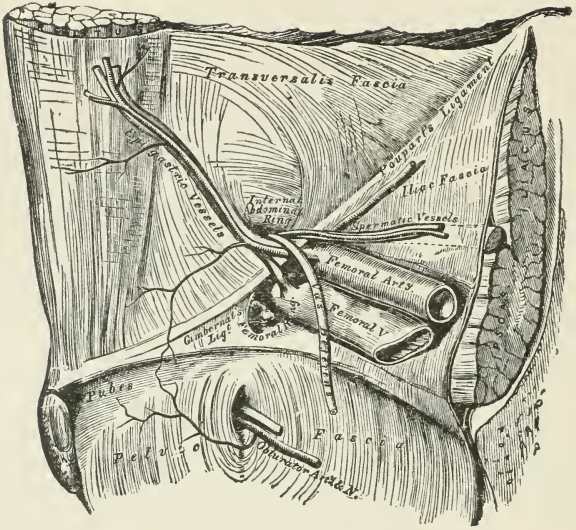

FIG. 11.

Hernia. The Relations of the Femoral and Internal Abdominal Rings, seen from within the Abdomen, Right Side. —GRAY.

The Hernial Sac and parts, the subject of this drawing, were discovered in the course of a dissection. The tumor did not present those external indications that led to a suspicion of its existence until the superficial and cribriform fascia had been cut through. The engraving was made from a cast and drawing of the parts taken by Mr. E. Wilson, and is well adapted to show the parts prior to their alterations by disease. The sac is denuded of its fascia propria.—WARREN.

a a, upper layer of the iliac portion of fascia lata; *b b*, pubic portion of the same fascia forming the floor of the femoral fossa; *c*, falciform process and portion of the border of the saphenous opening; *d*, external, or semi-lunar, portion of the same border; *e*, Burns' ligament, or pubic portion of the arch formed by the border of the same opening; *f*, inferior pillar of the external abdominal ring; *g*, spermatic cord; *h*, saphenous vein; *i*, hernial tumor.

The last two paragraphs above refer to Fig. 13, page 104. They were inserted under Fig. 11 by mistake.

tum, a layer of fatty tissue is usually found, lying directly upon the peritoneum. This is important, chiefly, since it might be mistaken, in a hernial protrusion, for omentum.

It is easily understood from a study of the anatomy of the parts, that the femoral ring, although reenforced and protected in such a marvellous manner, must be a weak point in the abdominal wall. By congenital defect, in laxity of tissue, or long-continued pressure, the peritoneal covering over the ring becomes pouched, and a lodgement of abdominal contents serves as a wedge to force open the canal. The greater size of the canal in woman, together with the firmer character of the inguinal ring, renders this variety of hernia more common in the female.

The abdominal contents which make up the tumor carry before them the peritoneum, which forms the hernial sac. External to it, are delicate investments of connective tissue layers, derived from the sub-peritoneal fascia and the septum crurale. Sir Astley Cooper named the sub-peritoneal layer of connective tissue the fascia propria, and describes it as thicker than the peritoneum, close and firm in its texture, embracing the whole of the tumor to its very neck; more or less adipose tissue is interposed between this layer and the peritoneal covering of the tumor. Although these layers of fascia are important and have been described by the earlier anatomists at great length, they are often so blended and fused, as to defy dis-

tinction. It is well to remember that the investment of a femoral hernia should consist of peritoneum, fascia propria, septum crurale, crural sheath, cribriform fascia, adipose tissue, and integument. All combined, usually, makè a very thin covering of the tumor, and their dissection should be conducted with even greater care than in inguinal hernia.

The contents of a femoral hernia are similar to those of inguinal. Omentum, however, is usually less common and is rarely found unassociated with a loop of intestine. Sir Astley Cooper states, he met with omentum, as the only contents of the sac, but twice. Mr. Lawrence observes that he has seen it more frequently. Hesselbach described a case where the ovary and tube formed the contents of a crural hernia of the left side. Femoral hernia is necessarily subject to comparatively few and unimportant variations. In rare instances, the hernial sac is found on the outer side of the femoral vessels in front, or even behind them.

The tumor usually descends vertically, through the crural canal, along the inner compartment of the sheath of the femoral vessels, as far as the saphenous opening. Here the sheath is greatly narrowed and in close contact with the vessels; the superficial fascia and crural sheath are closely attached to the lower part of the saphenous opening, and, by these obstructions, the tumor is prevented from extending lower. In its farther progress it is directed forwards, carrying

before it the cribriform fascia, and curves upwards upon the falciform process of the fascia lata and lower part of the tendon of the external oblique, retained only by the superficial fascia and integument.

When in the canal, owing to its firm, resisting walls, the hernial tumor is small, but after escaping from the saphenous opening, it may become of considerable size. "In the female it is generally very movable and being soft, and the skin not being discolored, it has the appearance merely of an inguinal tumor of one of the absorbent glands; but in the male, the skin is generally not so loose, the swelling not so distinctly circumscribed, and the tumor appears buried more in the substance of the thigh.

The largest size to which I have seen the tumor arrive was in cases of which I have given plates in this work. The one was in the male, the other in the female; they were each of them about the size of the fist, and each occupied the whole of the hollow, from the anterior superior spinous process of the ilium, to the tuberosity of the pubis. But my friend, Mr. Thompson, Professor of Military Surgery at Edinburgh, mentions a case of a woman, laboring under an old irreducible crural hernia, in whom the tumor extended half way down the thigh. In this case the parietes of the abdomen were so thin, that the peristaltic motion of the intestine could be distinctly perceived. Upon the whole, however, it is unquestionable, that the crural hernia is comparatively smaller

than the inguinal, and, on this account, it is the more dangerous."*

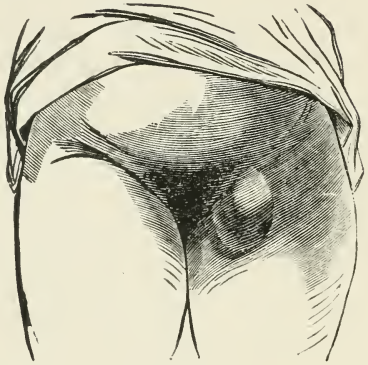

Fig. 12.

Femoral Hernia.—Agnew.

In femoral hernia, the location of the stricture varies. It may be found in the neck of the hernial sac. This, however, is rare; more commonly, it is found at the junction of the process of the fascia lata with the edge of Gimbernat's ligament, or at the margin of the saphenous opening.

Usually, the division of the stricture should be made upwards and inwards. This is the rule, unless the disposition of the vessels should contra-indicate.

The edge of the constriction is usually sharply

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* Sir Astley Cooper, Opp. Cit.

defined, and its division, to the extent of two or three lines, is generally sufficient.

Femoral hernia is recognized by the same general symptoms as inguinal hernia. When reducible, it disappears in the recumbent position, to return when erect; it is distended upon coughing. Its intestinal contents are elastic and uniform to the touch, and a gurgling sound is heard when it is returned into the abdomen. The surface is less equal and has a doughy feel when omental. Femoral hernia is usually diagnosticated without much difficulty, since tumors of the groin are much less common than of the scrotum. There are conditions, not infrequently, however, where the diagnosis is not easily determined. Cases are reported where the intestine was divided under the supposition that the tumor was a suppurating bubo; also where, under a similar supposition, poultices were applied, and death supervened from gangrene of the enclosed intestine. An enlarged gland may also complicate the conditions, occurring in conjunction with hernia. Cystic dilatation of a portion of the hernial sac may form a complication. I have very recently operated upon a woman of about 40, who had suffered from femoral hernia for twelve or thirteen years, much of the time, wearing a truss. A portion of the tumor became irreducible and the truss could not be tolerated, The sac was thick-walled and the lower portion was occluded and filled with serum, making a tumor the size of a small egg.

Varicosity of the femoral vein may be mistaken for a hernia. Sir Astley Cooper relates a case where he was consulted for a supposed hernia: "It was easy to detect the nature of the case, for, although it disappeared in the recumbent position, it was immediately reproduced, although she continued in that position, by pressing upon the vein above the crural arch, and retarding the return of the blood. She died of stricture in the colon; and, upon inspecting the body, I found that I could readily thrust my finger into the crural vein, but that she had no hernia." *

I have lately been consulted in a case of a limited varicose femoral vein, more than an inch in diameter, where upon standing a differential diagnosis was not easily made. I am assured, however, this condition is rare. Psoas abscess and fatty tumors should also be taken in consideration as possible. Mistaken diagnosis, confounding a femoral with an inguinal hernia, is not so very rare. This is of less inmportance in general practice, although intelligent efforts at reduction must depend upon a diagnostic recognition of the anatomical relations, and a femoral hernia goes over into a dangerous constriction of the intestine more rapidly than the inguinal. In operative measures, a correct diagnosis is of the first importance. Fatal errors have been made, otherwise avoidable.

Inguinal and femoral hernia may be rarely found

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* Sir Astley Cooper, Opp. cit.

occurring in the same subject. It is more common upon the right than the left side.

OPERATIVE MEASURES.

Attempt at cure of femoral hernia has been far less common than of inguinal hernia. Operative measurs have been instituted, in rare instances, except to relieve intestinal obstruction. When strangulation has occurred, the sharp, unyielding edge of the ring produces a much more dangerous constriction than in inguinal hernia, and calls for even more prompt measures of relief. Cases are on record where death has followed from strangulation within twenty-four hours after the accession of the symptoms. Not very rarely, forty-eight to sixty hours compression of the intestine will cause necrosis. This supervenes all the more rapidly in femoral hernia, since the size of the opening is small and the edge of the ring sharp and firm.

If reduction cannot be safely secured under ether by taxis, intelligently conducted, the thigh somewhat flexed and adducted, or rotated inwards, operation should not be delayed. Having relaxed the tissues, as much as possible, in this position, press gently directly downwards upon the tumor. Pressure is steadily to be kept up, for some minutes, until the surface of the tumor is brought even with the line of the crural arch, and then the compression is to be continued upwards and inwards, towards the abdomen. If, on the

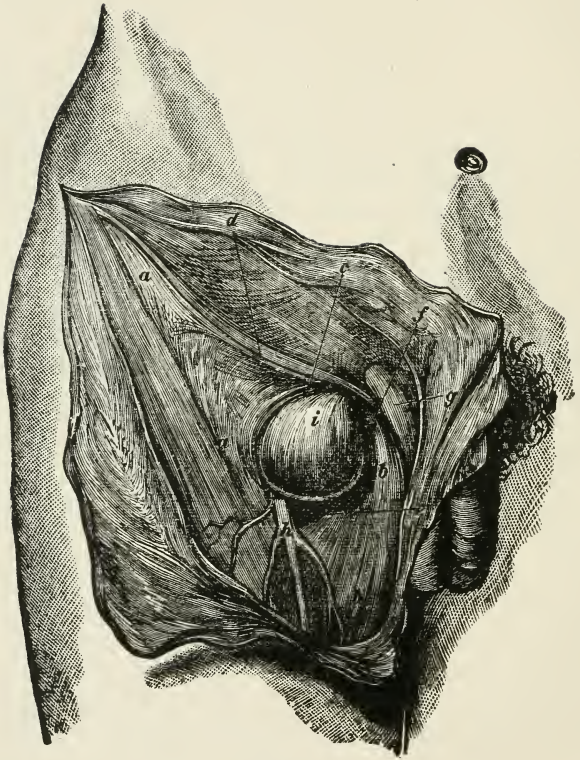

FIG. 13.

For description of this cut see page 96, second paragraph, *et seq.* under Fig. 11. This description inserted under Fig. 11 by mistake.

contrary, the pressure is first directed towards the abdomen, the tumor is carried over the arch, instead of under it, and the greatest danger may ensue from force thus applied.

The direction of the incision, through the integuments, may be somewhat varied, but usually it should be nearly vertical, and from two to three inches in length. It should extend downwards upon the inner side of the neck of the sac, and be continued upward, about one inch above Poupart's ligament. If the incision is slightly curved, the concavity should embrace the neck of the tumor.

After the division of the integuments and fascia, usually a well-defined, membranous sac comes into view, and the land-marks to be especially sought, as guides for the safe manipulation of the sac, are Poupart's ligament above and in front, and Gimbernat's ligament, at the pubic border, upon the inner side.

Expose clearly Poupart's ligament in the dissection, and determine with the finger, the edge of Gimbernat's ligament upon the inner side of the neck of the sac. The more common practice is, not to open the sac, but on the finger carry, with care, the hernia knife between the ligament and neck of the tumor, and cutting inwards, divide a few of the fibres of the ligament. This done, usually, in very recent cases, the tumor may be reduced en mass without opening the sac. The operation thus conducted, is generally

simple and safe, and may be selected if only relief from the intestinal obstruction is sought. Even then, it must be determined that the stricture has been limited to a few hours, and that the intestine has

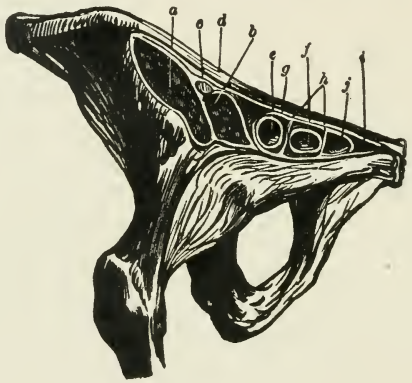

FIG. 14.

a, muscular portion of the crural arch occupied by the iliaeus internus; *b*, psoos magnus; *c*, crural nerve, with iliac fascia in front; *d*, Poupart's ligament; *e*, femoral artery; *f*, femoral vein, with the iliac and transversalis fascia separating at the inner edge of the muscles, *g*, and passing in front and behind the vessels to form their sheath, with its vertical membranous partition, *h*; *i*, Gimbernot's ligament; *j*, femoral ring.—AGNEW.

escaped injury from taxis. Should it be preferred to operate in this way, the conditions to justify it would be manifestly exceptional, and, under the protection of antiseptic measures, little if any additional danger ensues from the major operation. I cannot doubt the

wisdom and great advantage of adopting, as the rule of practice, the opening of the sac before any attempt is made to divide the stricture. In doing this, the fascia propria is divided on a director, when a layer of fat, already referred to, is exposed to view. This is important, since it might be mistaken for omentum. Having exposed the peritoneal covering of the sac, this should be determined and opened with the care and caution already emphasized, when describing this step of the operation in inguinal hernia. Generally, a little serum escapes, which farther determines the anatomical relations of the parts. Enlarge the opening sufficient to admit the finger, and, held in this way, free the sac from its surrounding attachments. Carefully carry the hernia knife on the finger, and divide the constriction, at its mouth, by cutting inwards and upwards, as little as required, to liberate the intestine. Then examine, and if warranted, restore the abdominal contents. The next step is to free the sac quite within the ring and making it tense sew through its base evenly, with double, animal suture, as advised in inguinal hernia. Cut the sac away, and return the sutured base within the ring.

Protect the femoral vessels in their sheath by pressing them gently outwards, and introduce the needle, as directed in inguinal hernia, from below, through the falciform process of the fascia lata, avoiding the internal saphenous vein, upwards through Poupart's ligament, withdrawing the opposite end of the

suture with the needle. A second stitch is taken through the same tissues, parallel to the first, about one-fourth of an inch nearer the median line; the third is introduced through the *pubic* portion of the fascia lata, parallel to the saphenous vein, and is carried upwards to include Gimbernat's ligament, or its divided fibres, if cut in strangulation; a fourth, and as many more stitches as may be required to close the saphenous opening, is carried below and parallel to Poupart's ligament, through the pubic fascia and the falciform fascia. In this way the peritoneal pouch is obliterated and the neck of the sac firmly closed.

The animal suture is carried parallel to the femoral vein; the strong tendinous borders of Poupart's ligament and the thick, reinforced edge of the fascia lata, above the saphenous opening, are closely approximated and firmly held, including the weakened Gimbernat's ligament. Thus the upper portion of the crural ring is closed. The lower part of the canal is obliquely elongated, and reformed by drawing inwards the weakened, dilated upper and outer border of the saphenous opening and attaching it to the firm pubic fascia. The folding over of the fascia, in this way, carries the saphenous opening quite a little to the inner side of its former site, while the femoral vessels are undisturbed in their sheath. The superficial tissues and skin are closely held in conjunction by buried sutures and the wound dressed with iodoform collodion, as advised in inguinal hernia.

In many instances, the incision and dissection will not be required to be made as extensively as above advised. Experience will familiarize the operator with the anatomical relations, but the open wound should enable him clearly to distinguish the vessels and render certain the closure of the parts involved. The operation for the cure of femoral hernia is, without doubt, more difficult than in inguinal. Properly done, it is almost without danger, and the wearing of a truss in this variety of hernia is much more troublesome. I cannot doubt operation for its cure will be much more frequently resorted to than at present.

Dr. John Wood, of London, is world-wide famous for his subcutaneous wire suture for the cure of hernia, and, although I shall refer to his methods later, when discusssing the various ways devised for this purpose, I quote here his operation for closure, after herniotomy, with the purpose of cure.

"When under the spray the sac has been opened, the stricture divided, the bowel and omentum drawn down and examined carefully, and the former found not essentially injured, with no ulceration at the strangulated part, and no appearance of sphacelus, the operation should be concluded by tying up the neck of the sac by strong catgut, at the level of the crural ring, and cutting off the sac just below. If the sac be large the catgut should be made to transfix it, and should be tied tightly on either side. Then after passing the needle through Poupart's ligament on

the one hand, and through the pubic fascia lata and Gimbernat's ligament on the other, as above described, the needle should again be passed horizontally through the pubic fascia lata, just below its insertion into the pectineal line, and the inner end of the wire hooked on and drawn through. Then the two ends of the wire should be twisted together, and the loop drawn up and twisted firmly down into the upper skin puncture. A drainage-tube should next be placed in the lower part of the wound, reaching as high as the closed crural ring, and two or three points of suture applied. Upon the protective, a double pad of wet, carbolized gauze should be placed. so arranged that a groove is left to lodge the end of the drainage-tube, and to give free exit for any discharge.

Then the rest of the antiseptic dressing is to be applied, with plenty of loose padding, especially on the inner side, to absorb the discharge, and a spica bandage above all. If the discharge does not soak through, the dressing may be left for three days, when, if primary union has occurred, as is most likely, the stitches may be removed and the drainage-tube cleansed and reapplied, shortened by about half an inch. In another three days the dressing should be changed, and the wire removed, the tube, again shortened, being kept in until the next dressing in three or four days more. The tube will then generally require removal.

I have operated for the radical cure of crural

hernia by the wire operation, directly after the operation of herniotomy for strangulation, in four cases, all in women. In the first two the spray was not used, but all the other antiseptic precautions were employed. In the last two, the spray and Lister dressings were used. All the patients recovered without a bad symptom, each having a good, firm, resisting cicatrix; no return of the rupture has occurred, as far as known, up to the present time.

We should no doubt be prepared to expect a higher rate of mortality in this operation than in that upon unstrangulated hernia. Very much will depend upon the care and judgment of the surgeon as to the condition of the bowel and omentum, before venturing to return them into the abdomen, and upon his choice of cases in which strangulation is recent. With due caution we may expect confidently that no higher rate of mortality than is met with in ordinary crural herniotomy, will be experienced. And if so, it certainly seems to be a shortcoming in surgery not to take advantage of the open wound, to cure, if possible, the hernia, by the same operation as that which is necessary to relieve strangulation. It is well known that by not doing so, the hernia is left to become larger and more troublesome to retain, because of the crural ring being cut so as to be more open and unprotected than before the operation. To be successful, as a rule, cases must be operated on as soon as possible after a fair trial of the

taxis, aided by inversion and anæsthesia, has been made. But this rule, also, operates favorably in an operation which is usually successful in saving the patient in inverse proportion to the amount of damage done, chances lost, and time misemployed by ill-directed and unskillful use of the taxis or other futile methods of treatment; and this especially in thin, feeble, female patients after the middle period of life."†

†Article on Hernia. John Wood, International Cyclopœdia of Surgery, Vol. V, p. 1161.

CHAPTER VIII.

OBTURATOR HERNIA.

The obturator artery passes forwards, below the brim of the pelvis, to the groove in the upper border of the obturator foramen, and escapes through this opening from the pelvic cavity. The oblique canal thus formed by the horizontal branch of the pubes above and the arched border of the obturator below, is rarely the site of hernia. It has been described under various names, as obturator, after the canal, the hernia of the foramen ovale, the thyroid or sub-pubic femoral.

The hernial sac is never wanting, and consists always of a portion of the parietal peritoneum, carried before the contents through the canal. The sac is here generally formed slowly, because of the firmer attachments of the parts, and a careful history will usually elicit symptoms of localized pain, cramps, and derangement of the functions of the intestinal canal. When the canal is distended the pain over the course of the obturator nerve, from pressure upon it, is at times a very diagnostic symptom. The canal, almost never, dilates to the extent found in other varieties, and, in the great majority of cases reported, the condition was not discovered until after death, since an external tumor is exceptional. Mr. Birkett, who has especially studied the subject, writes: "After passing

along the obturator canal, the hernial tumor emerges upon the thigh, below the horizontal ramus of the pubes, to the inner side of the capsule of the hip-joint; behind and a little to the inner side of the femoral artery and vein; and to the outer side of the tendon of the adductor longus. The tumor formed by the protrusion is covered by the pectineus muscle. From crural hernia, therefore, it may be distinguished by observing the relative positions of the horizontal ramus of the pubes and of the femoral artery. These structures occupy, in fact, a position between these two kinds of hernia. In obturator hernia, they are in front of the tumor; in crural hernia, they are behind it. In the former, then, they are easily felt; in the latter they cannot be without difficulty—not perhaps until the hernia is reduced.

In those cases in which either a fullness, slight hardness, tumefaction, or swelling exists, coupled with well-marked indications of obstruction, or strangulation in some part of the alimentary tube, the difficulty of diagnosis is not so very great; but how much embarrassment arises when those symptoms which betoken strangulated bowel exist, and a tumor is nowhere to be felt, let the numerous cases on record attest, in which the rupture has only been found after death." *

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* System of Surgery. Holmes. Vol. II, page 741. American edition.

When the symptoms of intestinal obstruction exist, a differential diagnosis may sometimes be impossible. Localized pain, especially over the distribution of the obturator nerve has already been referred to. Movements of the hip joint may be painful, especially rotation outwards, since this compresses the canal. Localized comparison and pressure over the obturator foramen of each side is important; also a careful inspection of Scarpa's triangle on each side. The pelvic opening of the obturator canal can be felt by the finger in the vagina, or rectum, and the additional evidence which such examination will give should never be omitted. Having detected a hernial tumor, the effort at its reduction should be carefully made. The pressure should be directed in a manner to free the hernia from the ramus of the pubes and carry it upward from beneath. To divide the constriction, it is necessary to make a careful, rather deep dissection through the integuments, in a line parallel to, and quite inside the femoral vessels. The pectineus muscle is divided and separated, and also very likely the fibres of the obturator. Until this is done, the finger can hardly be carried within the canal. The stricture should be divided inwards, as less likely to injure the obturator artery. Sir Astley Cooper relates a case operated upon by M. Arnaud, where a portion of omentum was removed, with the sac, followed by cure, but he criticizes the operation as needless and states that in a case of strangulation

where other measures have failed, "the operation of cutting the ligament which embraces the sac is the only hope of preserving life. This operation must be extremely difficult, and so far as I am informed, it has never been performed." According to Lawrence, the elder Arnaud is entitled to the honor of having first demonstrated this variety of hernia. Duveney met it post-mortem, and communicated his observations to the Royal Academy of Sciences, but they were not printed in their Memoirs.

In a female, upon both sides of the pelvis, the peritoneum had been protruded through the openings of the obturator canal and formed tumors, size of an egg.

They contained intestine, were placed between the anterior heads of the triceps and formed an external tumor. The first publication, in which the existence of an obturator hernia was clearly demonstrated, was by Garengeot.

In M. Cloquet's work there is described and figured a case of obturator entero-epiplocele which resulted in death.

Hilton* reports a case simulating intestinal obstruction within the abdomen, to relieve which, gastrotomy was performed.

According to Mr. Birkett,† the first surgeon to

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*J. Hilton, Med. Chir. Tr., Lond., 1848, xxxi, 323–335.

†Op. cit.

operate, followed by cure, was Mr. Obré, of London, in 1851. Patient a tall, stout female, aged 51. He incised the sac and its orifice and returned a congested loop of intestine.

The next report which I find was in 1853, by B. Cooper.* Division was made and contents returned; recovery slow, but satisfactory.

The same year, operation and cure by M. Case.†

Since the above dates, I have found reports of twelve operations undertaken for obturator hernia, with seven recoveries.

I have met this variety of hernia only once. A girl of twelve years was supposed not seriously ill until three days before death. She received a severe strain from sliding down the banister-rail of a stairway. Continued at school the following day, was seized with symptoms of intestinal obstruction, stercoraceous vomiting, and was in extremis, when I was summoned by Dr. M. D. Church, of Cambridge. There was an illy-defined tender tumor upon the inner side of the thigh, below the pubes, the size of a small egg. The abdomen was tense and tympanitic. The fact that strangulation had existed for so long, caused taxis under ether to be undertaken with more than the usual care. Failing in this, and fearing the intestine necrosed, and possibly farther intra-abdominal

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*Med. Times and Gazette, London, 1853, N. S. vi., 113.
†Bull. gén de Thérap., Paris, 1853.

complication, I determined to perform laparotomy. I was aided by Drs. Church and G. W. Nash. By careful manipulation of the intestine, gentle pressure being made upon the tumor, a loop of darkly congested, small intestine was withdrawn and the wound closed.

The recovery from ether was, unfortunately, complicated by the vomiting of an enormous quantity of dark fluid, a quart or more. The prostration was extraordinary, and death supervened in a few hours.

This, and one or two other instances of the gravest character, have taught me to feel that, in such severe cases, a careful washing out of the stomach before operating is of the first importance.

A most interesting case is reported by Welsch,* where a portion of the end of the processus vermiformis and a very small part of the urinary bladder were carried into the sac. An abscess supervened, followed by death.

Although rare, this variety of hernia has been here treated at the greater length, since, in most works, it is scarcely more than alluded to. I have no doubt it often escapes observation, and death from obscure abdominal inflammation is the verdict generally rendered. Since the great majority of hernial cases must come under the observation of the general practitioner, it is well to emphasize the possibility of this very dangerous variety of intestinal obstruction.

*Med. Cor. Bl. d. Würtlemb. ärtzl. Ver. Stuttg., 1862.

ISCHIATIC HERNIA.

A few cases of this rare variety have been recorded. The tumor cannot be discovered until of a considerable size, since it is covered by the gluteous maximus. Lawrence wrote that, "it has never been diagnosticated upon the living subject."

Sir Astley Cooper relates, at length, a case dying of intestinal obstruction, where the autopsy showed a strangulated ischiatic hernia, and illustrates it with two plates. Camper also records a case where the ovary was in the sac.

Should ever the question of operative interference be deemed advisable, Sir Astley Cooper recommended that the safest direction, in which the orifice can be dilated, will be directly forward.

The weakening of the pelvic floor in woman, from child-bearing, is a common cause of a downward displacement of the pelvic contents. By the earlier writers, quite a number of these lesions were described under different varieties of hernia, as pudendal, vaginal, and perineal hernia, also hernia of the urinary bladder, as cystocele. All these displacements are important and interesting, but come more properly under discussion in the consideration of the injuries and diseases of the female organs, rather than in a general treatise upon hernia.

Mention has been made, in a number of instances, where the urinary bladder entered, in part, into the composition of the hernial tumor. A very rare variety

is illustrated by a few well authenticated instances, where a portion of the bladder had passed through the abdominal ring into the scrotum, and slowly enlarged to extraordinary size.

I have never met with this variety of hernia, but when present, its diagnosis would not be difficult, and in certain conditions, operative interference would be justifiable for its restoration and proper retention.

UMBILICAL HERNIA.

This variety of hernia might have been placed in order after inguinal, since it is of such frequent occurrence. I have, however, thought best to discuss the herniæ of the pelvic region, as a group.

The connective tissue which closes the umbilical opening is much thinner than the surrounding parts, and the peritoneum is very much more closely adherent than at any other portion of the linea alba.

The umbilical opening, through the tendon, is not larger than a quill, and is formed, like the apertures we have already considered, for the escape of vessels. It will be remembered, however, that these vessels are extra-peritoneal in their development and course. The umbilical arteries arise from the internal iliac arteries by the side of the bladder, and are continued to the navel, between the peritoneum and muscles. The umbilical vein, after entering the ring, is continued between the peritoneum and muscles; this forms the round ligament of the liver. Thus we see

the peritoneum, in normal development, is never absent beneath the umbilical site.

Umbilical hernia is often seen in infancy and childhood, but is usually small and easily controlled; it frequently protrudes in a pointed, dependent tumor, generally contains intestine, is easily returned, but usually sensitive upon pressure. Derangement of the digestion is frequently dependent upon it.

In adults, the tumor is in considerable variety of shape and appearance.

This is dependent, less upon the size of the opening, than upon the resistence offered to its extension. In thin persons, it becomes pendulous, circumscribed, and often pyriform, in shape. In fat people, it often extends upwards, as much as in other directions, is sometimes flattened, and quite concealed by the thick, abdominal wall.

The coverings of the sac are, usually, intimately blended, and often distended, so as to be extremely thin. Then, nothing of anatomical factorage can be determined, and, even the peritoneum which always lines the sac, can scarcely be differentiated. The sac, in rare instances, may be double.

The contents of the sac may be intestinal, omental, or both; in large hernia, usually intestine and omentum. The contents can be generally distinguished without difficulty.

Women are much more often the subject of umbilical hernia than men.

This is dependent, in the large part, upon child-bearing, the distension of the abdomen by the gravid uterus, pains of parturition, ovarian tumors, etc. Women who have borne many children, producing a loose, pendulous abdomen, and then becoming corpulent, are more liable to large umbilical hernia than any other class. In these instances, the omentum has generally become thick and heavy from a deposition of fat.

Children are, sometimes, born with a deficiency of the structures about the umbilicus. At one side of the cord, there may be seen a considerable protrusion, with only the peritoneal covering, through which the intestines may be seen. Rarely, even this may be wanting. An illustrative case with photograph was furnished me by Dr. William Hogue, of Charlestown, W. Va. The boy was born with non-closure of the abdominal wall. The intestines passed through the opening and extended as far as the pubes. The opening was about two inches in diameter. The child was, otherwise, well developed. The bowels were replaced, leaving the funis out, and the abdominal walls were drawn together by adhesive plaster. The opening was permanently closed, in about six weeks.

In attempting the reduction of an umbilical hernia, the recti muscles must be relaxed. A knowledge of the character, contents, shape, and tension of the tumor must direct as to its manipulation for re-

duction. Often grasping with the hand, and directly lifting it from the ring will materially aid in its reduction, at the same time, gently kneading the neck of the tumor with the other hand. Once reduced, it is important to retain it with a truss. Instruments, in some variety, are to be found, but the essential is compression over the opening. This is often made, easily and effectually, by a firm bandage around the body, with a conical-shaped pad to fit the depression.

Umbilical hernia may become irreducible from the same canses which produce irreducible hernia elsewhere. The most frequent is the adhesion of the omentum. When irreducible, the tumor, sometimes, grows to an enormous size, disabling the sufferer, if not endangering life. Rarely, ulceration of the integuments occurs, thus greatly complicating the suffering.

Some years since, I had under observation a large hernia, where the ulceration was so extensive as to lay bare, to a considerable distance, both recti muscles. The abdomen was of very exceptional weight, and cure was effected only by support and prolonged rest in the horizontal position.

A large cup or basin-shaped pad may often be of value to retain an irreducible umbilical hernia. When this is impossible, because of size or pendulous shape of abdomen, a support, as a broad belt, carried over the shoulder, can be arranged to relieve, in part, the weight.

Strangulated umbilical hernia is not infrequent. It may not be as urgent as in inguinal or crural, yet Sir Astley Cooper narrates a case which proved fatal within eighteen hours. The danger, of course, lies in the close constriction of the neck of the sac. Here the opening through the linea alba is a circumscribed ring, entirely inelastic and firm, resisting the knife like cartilage. The intestine is often, in a measure, protected by a thick pad of omentum. In one instance of a strangulated umbilical hernia, where stercoraceous vomiting had continued for three days, a patient of Dr. H. L. Chase, of Cambridge, I freed a loop of very dark colored intestine, slightly ulcerated at its mesenteric attachment, and returned. It was surrounded by a mass of necrosed omentum, double fist size. This was sewed through beyond its constriction, and excised. The entire sac was resected by oblique incisions, and the walls united, followed by a rapid and permanent cure. The intestine undoubtedly escaped necrosis because of its omental surrounding.

In operation, it is usually safer to open the sac by direct incision in the median line. This is ordinarily easy, as the sac is very thin. Of course care is required not to injure the intestine. Sometimes the sac is so tense that the contents are at once pushed out and are troublesome. Covered by an aseptic towel, they are carried to one side, and the constricting ring is divided by the knife on the finger. After a proper determination of condition, return the abdo-

minal contents. This done, I do not for a moment, hesitate to commend, in all cases, a complete resection of *sac* and *ring* by eliptical incision, and close carefully the abdominal opening, as in an ordinary laparotomy. This I think best accomplished by closing, in at least three lines, with a continuous buried animal suture, first the peritoneum; and then the subsequent steps can be conducted under irrigation. The second layer should be with large suture, taken deeply and widely, for the better support. The skin is also approximated and the wound dressed with iodoform collodion, as recommended in inguinal hernia. Sometimes, the tension upon the abdominal wall is very great, because of contents. I have, in one or two such instances, carried silver wire interrupted sutures quite outside the coapting animal suturing, to act as a splint, holding the structures at rest during repair.

The treatment of necrosed intestine has received a new interest in the light of modern research. I have four times resected a portion of the diseased bowel and closed the inverted edges by continuous animal suture taken in a modified Lembert stitch, through double layers of the peritoneal coat. A second row of sutures was taken about one fourth of an inch from the first, both entirely encircling the intestine; all proved fatal. Subsequent autopsies, in three cases, showed absence of peritonitis and a local exudation enclosing the suturing; death apparently from exhaustion, in large measure, antecedent to

operation. In one case, seen with Dr. H. C. White, of Somerville, the umbilical tumor was size of baby's head and already necrosed. We resected seven inches of small intestine, together with large masses of gangrenous omentum. Death supervened in sixty hours. No hemorrhage or peritonitis. The intestine, at point of juncture, held water after removal from the body.

To Dr. H. R. Storer,* of Newport, R. I., formerly of Boston, is due the credit of having first, in America, deliberately undertaken the cure of umbilical hernia. This was in 1866, and was followed by primary union.

Before the days of the proper understanding of the active ferments, as factors in the surgical problem of wound treatment, emphasised by the most serious results, whenever their incubation occurred within the abdominal cavity, we may well understand the fear and trembling associated with the name of peritonitis. The experience of the centuries had taught it to be the "noli me tangere" of surgery. Upon this, in large share, is yet based the general belief of the medical profession, to defer operative measures as a last resort. This has been emphasized, in a much greater degree, in the consideration of operative measures undertaken for the cure of umbilical, than of inguinal hernia. The time is not far distant when the cure of this often-times disabling and dangerous condition will be considered, as safe and simple, as

* N. Y. Med. Record, 1866-67, p. 73-76.

an exploratory laparotomy, and under proper conditions almost entirely devoid of danger.

Diaphragmatic and ventral hernia, as also the various herniæ, which cause intestinal obstruction, occurring within the abdominal cavity, are omitted from discussion as not within the scope of this work. Abdominal surgery, however, has, at the present, invested these conditions with an interest and profit never before associated with these pathological factors, and very many lives will be saved in the future, where even now, no hope is entertained. Every physician, as well as surgeon, should familiarize himself with all the conditions of impaired intestinal function which may indicate obstruction in its earlier stages, and be able to profit thereby, either by a wise interference on his own part, or calling to his aid the more experienced.

CHAPTER IX.

THE RADICAL CURE OF HERNIA.

Few chapters in the history of surgery are of greater interest to the student than those in which are recorded the efforts made during the centuries for the cure of hernia.

In the earlier writings, a very great variety of external applications were advised. These were, for the most part, inocuous, often consisted of pads variously constructed of supposed medicated materials, and were of value as supports. When applied to the young, they often aided in cure, and were, on this account, commended as of value. Vesication was also resorted to. The cure by cautery was known to the Arabians, and is mentioned by Avicenna, Albucasis, Paulus Ægineta, Fab. ab. Aqua pendente, and others. The method employed was, after the patient's intestinal canal had been emptied by fasting and purging, to cauterize the projection of the tumor, previously marked in ink, for which instruments, in variety of shape, had been devised. Nearly all its advocates agreed that the result must effect an exfoliation of the os pubis, the patient must be restrained upon a low diet, and retained in bed for a very considerable period. A support must be afterwards worn, since the hernia easily returned.

The caustic treatment appeared to succeed the

cautery and to have been advocated for similar reasons. An eschar, about one inch in diameter, was to be made over the external ring, and by repeated applications, to destroy the tissues, including as much of the sac as could be safely done without injury to the cord. The object to be attained was a cicatrix firmly closing the ring. This procedure was in use for a considerable period, and was advocated by Guido, Severinus, Lanfranc, Parey, Scultetus and others. Many dangerous complications and unsatisfactory results are recorded by these writers.

The danger, the suffering, the frequent return of of the hernia behind the cicatrix, compelling the use of bandages, caused these measures gradually to fall into disuse.

As improvements upon the above methods, followed the *punctum aureum*, *the royal stitch*, and *castration*. Since the two former were attempts in the direction towards which the pendulum of modern opinion has again swung, I quote from the ever interesting work of Percival Pott, a surgeon famous for all time: "The punctnm aureum was performed as follows: The bowel being emptied by purging, and the hernia reduced, an incision was made through the skin and membrana adiposa, down to the spermatic process. This incision was to be of such length, as to permit the operator, either with his finger, or a hook, to take up the said process, and to pass a golden wire under it; which wire was to be twisted in such a man-

ner as to prevent the intestine from slipping down again into the hernial sac, but not so tight as to intercept or obstruct the circulation of the blood to the testicle. Some operators preferred a leaden wire to a golden one, and others used a silken ligature. * * * The royal stitch was performed in this manner: the intestines being emptied, and the portion which had descended being replaced, an incision was made in such a manner,as to lay bare the spermatic cord, about two inches in length from the abdominal opening downward. When the process was freed from the cellular membrane, it was to be held up by an assistant, while the surgeon with a needle and ligature made a continuous suture, from the lower part of the incision to the upper, in such a manner as to unite the divided lips of the wound again, comprehending the cellular membrane, and thereby endeavoring to straighten the passage, as they called it, from the belly into the scrotum, without injuring the spermatic vessels. The operation is described by many of the old writers, with some small variation from each other, both in the manner and in the instruments; but all tending to the same end and all proving that their idea of the disease and of the parts effected by it, were erroneous and imperfect."

This operation was modified by some surgeons, and not infrequently is resorted to, even at present, in the treatment of the wound, after strangulation has been relieved, by treating it as an open wound. The

result, even in practical hands, gave, not infrequently, abscess of the scrotum and destruction of the testicle, while the cord remaining, prevented the closure of the ring.

Although called the royal stitch, since by its use it was hoped the testicle might escape, and by physiological process, subjects for the king result, it became evident that the cure would be much more satisfactory by the removal of the testicle and complete closure of the canal.

In ecclesiastics there seemed to be no special objection to the removal of the testes and the practice gradually grew to be common, until by a report presented to the Royal Society of Medicine, in 1779, it appears that the Intendent of the Police of Paris had observed that many individuals, who came under his inspection, previous to entering the military service, had been deprived of one or both testicles, in operations for the cure of hernia. The Bishop of St. Papaul found, "that more than five hundred children had been castrated in his diocese, and more than two hundred had been mutilated at Breslaw."* The inference is clear, although in the hands of the ignorant and designing, the operation was often needlessly performed; that the removal of the sac and cord gave the opportunity of making, in this way, a firm closure of the ring which resulted in a permanent cure. Such,

* Lawrence on Ruptures, page 102.

however, became the frequency and abuse of this method, that it was interdicted by law.

The distinguished Prussian surgeon, Schumucker, dissected away the sac and opened it to be sure that it was empty, and then ligaturing as closely as possible to the ring, cut it away. This he did in two cases. The elder Langenbeck carried the results of his investigations to such legitimate end that I quote the translation, as given by Lawrence:*

"I divide the integuments over the swelling, without pinching them up into a fold, clear the hernial sac, push back the prolapsed parts, and place a ligature on the neck of the sac close to the ring. The tightening of this ligature gives no pain. If the sac has been completely detached from all its connections below the ligature, it perishes. If, on the contrary, it has been separated only sufficiently for passing the ligature, and still remains connected to the scrotum below, it becomes inflamed and the scrotum itself is affected with inflammatory enlargement, as after the radical operation for hydrocele. The detachment of the ligature occurs from the ninth to the fourteenth day. If the case is an external inguinal hernia, the sac must be separated from the spermatic cord. I detach it just below the ring, to a sufficient extent to allow the application of the ligature, and leave the rest undisturbed in its situation. To separate the entire

*Bibliotheck für de Chirurgie, B. ii, 1808.

sac from the scrotum and from the tunica vaginalis propria testis would cause much irritation. The operation is much easier with small ruptures, which have not descended into the scrotum, and in internal inguinal hernia, where the spermatic cord, with its tunica vaginalis communis, lying on the other side of the swelling, is not so closely connected to the sac. It is most easy in femoral herniæ where the entire sac can be readily cleared. I have already performed this operation twelve times with the most successful results, and all the patients are capable of the hardest labor without wearing a truss. Two years have elapsed since I first put my method in practice on a youth of sixteen with a large scrotal hernia, in whom there is at present no appearance of a new protrusion. A year ago I operated on a crural hernia in a female domestic, who does the hardest work without having experienced any return of her complaint. The ligature causes adhesive inflammation of the serous surfaces and the neck of the sac becomes closed up to the abdomen like the portion of an artery which has been tied."*

Lawrence, in commenting upon the operation, although he places great emphasis upon the importance of the sac as a factorage of hernia, states: "But in truth something more is required; we want a remedy that should contract the tendinous opening; for while that remains preternaturally large, a new protrusion is a highly probable occurrance."*

*Op. cit., p. 103.

This operation, however, found advocates. Arnaud, Sharp, Acrel, Petit, Abernethy, and others reported their experiences, but, while a considerable number of cures followed, several were dangerously ill, and a few cases resulted fatally. To combat the inflammations, as then understood, it is painful to note the bleedings, purgings, etc., undertaken for relief. Surgical operations, by what might be called the open method, for the cure of hernia, slowly fell into disregard only to be revived in our own time.

At least they fell into disrepute with the Faculty and were relegated to the hands of the peripatetic pretender who, for a long time, reaped a rich reward by cultivating this abandoned field of surgery, so strong was the desire of the suffering to obtain relief by any means promising cure.

During this period, we may trace a legitimate effort of the surgical profession, to profit by the monumental labors of Cooper, Camper, Cloquet, and Scarpa, and effect a cure of this distressing complaint. Their teachings, however, fell upon a barren soil in the subsequent generation, save in the hands of a few of the leading surgeons in general hospitals, where late operations were performed for the relief of strangulation, but were often fruitless because of delay, thus bringing these measures even into disrepute.

The teachings of the great master, Sir Astley Cooper, found a worthy American exponent in Dr. John Collins Warren, of Boston. Writing home to his

father July 9th, 1800, from London, then only tweuty-two years old, he states: "Mr. William Cooper, my old master, is succeeded by his nephew Mr. Astley Cooper, as lecturer; a young man of the greatest natural abilities, and almost adored at the hospitals. His practice is directly the reverse of his Uncle's. Old Mr. Cooper would say: "Let nature alone; she will open that abscess infinitely better than you can." The other says: "Had you dilated that abscess from top to bottom at first, it would have been well long ago."

The obligations that I am under to Mr. Cooper are infinite. He has always treated me with the most particular attention, and suffered no opportunity of instructing me to pass by. I wish it were possible to return, in the smallest degree, the favors with which he has loaded me."*

In the Warren Anatomical Museum, No. 2364, there is still preserved a portion of omentum 4¾ inches in length removed from a crural hernia where the strangulation had already existed seven days. Dr. Warren was then but twenty-seven years of age. Of his experience he writes:

"When I began to operate in Boston, many of the great and difficult operations had never been performed. My father had done a great number of amputations and extirpations, and had successfully

* Life of J. C. Warren, vol. 1, p. 37.

removed many cataracts. He had also repeatedly done the operation of lithotomy; that is, he did it, four or five times altogether. I have done it since then, including operations of lithotrity, thirty to forty times. But the operation for strangulated hernia, that of aneurism, and many others, had not been done in Boston. The first cases of hernia which I proposed to operate on excited great opposition on the part of friends of the patient, and surrounding physicians. In consequence of this difficulty, I lost two or three patients in the outset, from delay, one, an only son of the Rev. D. Baldwin; the other, an only son of B. B. Esq. In consequence of these occurrences, I determined to operate soon, or not at all. This became known to physicians, and they fell into the plan of operating early. Since this arrangement, I have lost scarcely any patients in operations for strangulated hernia. In the winter of 1805, I was summoned to the wife of Dr. C., of Amherst, N. H., and accompanied by Dr. Gorham, rode in an open vehicle on the snow, the best part of a cold night in February, to Amherst. The disease had lasted seven days. The hernia was crural and large. The intestines adhered to the peritoneum; and I dissected the peritoneum from the intestine through a large space; cut off a considerable portion of swelled omentum, which could not be reduced, and which is still to be seen at the Medical College; and reduced the adherent intestine. The patient

recovered and lived many years afterwards. The operation of strangulated hernia became at last so familiar, that it cost me no more anxiety than the extirpation of a tumor especially since the introduction of ether."*

For many years, I find no record of any attempt at revival of methods of cure. In 1828 Dr. Jameson,† of Baltimore, reported a case of cure following the dissection and implantation of a tongue of tissue into the crural canal. After plugging the canal, skin flaps were united over it, thus making a plastic operation covering the parts.

P. N. Gerdy published his method in 1835. This consisted of inflamming, by the application of ammonia, a portion of the skin of the scrotum and invaginating it within the ring and retaining it by suture through the ring. This operation was variously modified, the most interesting of which was the device of Belmas,‡ invaginating the ring with an inflated bag of gold beater's skin. The hernia was first returned, the sac exposed, and the empty bag carried as far as possible towards the neck or ring.

A canula fixed in the bag was then used to inflate it, where it was retained in the sac. Afterwards pieces

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* Life of J. C. Warren, vol. ii, p. 90.

† American Medical Recorder, Vol. II, p. 128.

‡ De la radicale des Hernies, Rev. med. franc. et étrong, Paris, 1838.

of gold beater's skin were used, instead of the inflated bag. A number of cures resulted. The chief interest pertaining to this operation lies in the experiments which led to its adoption, since M. Belmas determined that these tissues, when placed into the serous cavities of animals, became adherent and organized as a solid substance. These experiments are the legitimate antecedents of animal sutures, and might easily have led up to the incorporation of tendon or cat-gut thus applied for the closure of the ring. M. A. Bonnet,* of Lyon, published his method of the introduction of three or four pins through the integuments of the sac and the twisting of the point so as to compress the included parts—a sort of hare-lip pin. The wood pad was employed by accident by a laborer, with the result of cure. The pad was variously modified and called the Stagner truss. From the report of a committee appointed by the Philadelphia Medical Society in 1835, we quote: "An irritation of the skin and subcutaneous cellular tissue is produced by the pressure of the hard, unyielding and rugose block, and is gradually extended to the tendons beneath, as well as to the serous membranes of the sac, which is closed and obliterated at its neck, the whole mass of integument, tendon, cellular tissue, and the sac being agglutinated by the process of adhesion, in such a manner, as to oppose an insuperable barrier against the exit of the

* Bulletin général de Therapeutique, May, 1836.

intestine." Later, the pads were made smooth. I have seen excellent results from their use, and in one case followed by cure, in a young student, the pad was worn for a time under so firm a spring that it was nearly imbedded in the swollen parts. Only within a few days has a man presented himself wearing a truss with a thick wood pad of his own construction, which he stated "held him when all others had failed." It is probable such pads worn by the young would, in many cases, be followed by cure.

Wutzer,* of Bonn, improved upon Gerdy's method of invagination, by the invention of an instrument through which was carried the needle. Both were allowed to remain in situ for eight or ten days. A truss was recommended for some months subsequent. Permanent cure, however, seemed the exception.

RADICAL CURE BY THE USE OF THE SETON.

The use of the seton may be traced far back in the history of surgery, and when the inflammatory processes which supervene upon its use are taken into consideration, it is easy to conceive its supposed adaptability for the cure of hernia. The seton was introduced into the hernial sac for this purpose as a recognized measure early in the present century. No definite results are reported, and the practice has for

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*Wutzer, C. W. Weber. Radicale Heilung beweglicher Leistenbrüche, Bonn, 1840.

a long time been generally abandoned. Dr. Holthouse,* however, has given such an exceptionally interesting statement of its use, that I quote the following:

"Cases are sometimes met with in which, owing to the smallness of the inguinal canal, the finger cannot satisfactorily make out the structures involved in the operations which I shall have presently to speak of, and, under such circumstances, their performance cannot be altogether free from risk. For these the seton operation may be performed, and from my experience of it, derived, however, from a limited number of cases, I am disposed to regard it with more favor than is usually accorded to it. True, I have not done it of late years, but that is because I have met with scarcely any cases that were not amenable to the superior operation by the rectangular pins, which act both on the sac and on the canal. The following, however, is an example of the seton operation:

G. E., æt. 17, was admitted into the Westminister Hospital for an oblique inguinal hernia, which had descended into the upper part of the scrotum, and existed three months. It was easily reduced, and no truss had been worn for it. On the 31st of July, 1860, the bowels having been previously cleared by castor

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* On Hernial and other Tumors of the Groin and its Neighborhood, with practical remarks on the Radical Cure of Hernia, by Carsten Holthouse, London, 1870.

oil, a seton composed of eight threads of silk was drawn through the inguinal canal, the patient was put on low diet, and a grain of opium given at bed-time.

August 8th. Seton removed, very little pain or suppuration having been caused by it. Has not had any unfavorable symptom, and looks and feels perfectly well. Middle diet, with half a pint of porter, was ordered, and a truss with a weak spring was applied.

Aug. 10.—Continues well: some tenderness is felt on pressure over the inguinal canal, and the truss causes aching of the part; it was therefore removed, with an injunction to the patient to place his hand over the site of the internal ring during defecation or straining.

Aug. 21.—Discharged cured, but wearing a weak truss. Wounds very nearly but not quite healed.

Sept. 1.—Presented himself at the hospital, the wounds being now quite healed. The truss was taken away.

Oct. 13.—Continues very well, and has gained flesh. He is working as a bricklayer's laborer, without a truss.

August 31, 1861.—A month ago, or exactly one year after the performance of the operation, the rupture suddenly came down again, while he was making a violent muscular effort. He has been nearly constantly at work, without a truss ever since his discharge from the hospital.

Notwithstanding the hernia eventually returned in this case, the operation can scarcely be called an unsuccessful one. Indeed it appears extremely probable, that had the patient delayed going to work a little longer, or had he been in a station of life which called for less bodily exertion, there would have been a pronounced success. This view is supported, not only by the cures resulting from the use of a truss only, and to which allusion has already been made, but by the following dissection of a case in which this principle of operating was adopted.

A German, 47 years of age, affected with a scrotal hernia of the right side, was operated on by Prof. Carnochan, after Rigg's method, on the 2nd of May, 1857; the operation was completely successful; towards the latter part of July, pulmonic symptoms made their appearance, and on the 9th of September, he died of tuberculosis of the lungs.

Post-mortem, 10th of Sept.—Upon opening the cavity of the peritoneum, the orifice to the hernial sac could not be traced, the internal ring being firmly closed around the cord. On the outer side of the peritoneum, and just below the situation of the internal ring, was found a small rounded body of a yellowish color, supposed to have been the remains of the hernial sac. The upper portion of the inguinal canal, for nearly an inch, was closed by plastic exudation, which had become organized and somewhat fibrinous in its appearance; while the canal at its lower part

and the external ring were, to appearance, in their normal condition, though the cord throughout the entire length of the canal seemed to be imbedded in plastic formation. The skein of silk used in this case being too large for the puncture made by the instrument, it was not introduced more than one inch, which will explain the facts mentioned of the lower portion of the canal and external ring being in their normal condition; while at its upper portion, both the canal and internal ring were firmly closed. In explanation, it should be mentioned that Riggs' operation is identical in principle with the seton operation, sponge being substituted for the silk used in the latter. The mode in which to perform the seton operation is the following: "A fold of scrotum is carried up on the finger as high into the inguinal canal as possible; a strong curved needle set in a handle, and having a large eye near its extremity, is next passed along the palmar aspect of the finger, thrust through the anterior wall of the canal, and brought out on the surface, about half an inch or more above the centre of Poupart's ligament; it is then threaded with the number of threads previously determined on, and medicated or not, as the case may be, and withdrawn through the same opening at which it was entered. The upper and lower ends of the threads are tied together, and pressure made over the outside of the canal with a compress and bandage. The threads are allowed to remain in the canal till a sufficient amount of inflam-

mation appears to have been excited, and are then withdrawn at periods varying from three to nine days."

M. Velpeau operated a number of times by opening the neck of the hernial sac and introducing the tincture of iodine.

The success which so often followed the operation for hydrocele by injection led him to adopt its use for the cure of hernia.

An assistant compressed the inguinal canal, so as to prevent the fluid entering the abdominal cavity. A mixture of six drachms of tincture of iodine in three ounces of water was introduced, and after pressing it into all the parts of the sac, was allowed to escape. No serious symptoms followed but the results led him after a time to abandon its use.

Dr. Pancoast, of Philadelphia, in his work on Operative Surgery, published in 1844, reports the injection of tincture of iodine, or tincture of cantharides, one-half a drachm, introduced into the sac by means of a small syringe, fitted to a fine canula, which is first carried free into the sac. The canula was withdrawn and a compress placed under a truss directed to be worn. All were benefited. The cases numbered thirteen and were operated on in 1836. Some worked at farm labor a year after the operation without wearing a truss, and there was no return of the hernia.

Dr. John Watson, of New York, published upon the subject in 1851.*

The process of injection with iodine was revived in Paris, in 1854-7, with such results that cases are reported by Boinet, Demeaux, Jobert, Maisonneuve, Nelaton and Ricord.

The injection method, of by far the widest repute and general adoption, is accredited to Dr. George Heaton, of Boston. He first published in 1843.† The material used was a fluid extract of oak bark.

Dr. J. H. Warren, of Boston, the most famous of Dr. Heaton's followers, writes: "But the honors of the true hypodermic injection, without any preliminary incision, I think, after much careful research in the literature of surgery, belongs to the late Dr. George Heaton, of Boston, who, after eight years of discouraging experiment, discovered a process which I call *the method of tendinous irritation*, by the injection of a solution of quercus alba. Since he performed successful cures, by his new method, as early as 1840, and experimented, as he tells us, eight years previous to this, we are carried back to the year 1832, when he first conceived his operation. His first operations were with Dr. Jaynes of St. Louis."‡

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*The Radical Cure of Reducible Hernia by the Injection of Tincture of Iodine. N. Y. Med. Times, 1851.

†Boston Med. and Surg. Jour., 1843-4, p. 217-219.

‡Warren on Hernia, Second Edition, 1882, p. 129.

The operation, as performed by Dr. Heaton, created much discussion in Boston. It was generally adversely criticized, and his methods were claimed by some to be unprofessional. There can be little doubt he conscientiously pursued the investigation of the subject with enthusiastic devotion, and with good results, if not generally followed by entire cure.

Dr. J. H. Davenport edited Dr. Heaton's book,* which contains much that is novel and interesting. There is appended a list of 140 cases, "from the many hundreds," with brief notes of each.

Dr. Warren began operating upon hernia by the Heaton method, soon after the author's death. He states, in a note to his second edition,† "that he is convinced the credit of origination of the method belongs to Dr. Pancoast—that to Dr. Heaton is due the discovery of the exceptional value of the thick extract of the oak bark."

Dr. Warren thinks that this peculiar effect is due to non-absorbability of the particulate elements of the bark and, by their remaining in the tissues, a much greater exudation of the cell elements occurs.

Dr. Warren greatly modified and improved the instruments to be used, both needles and syringe, and has somewhat changed the medicamenta employed. Among the recipes commended, the following is preferred:

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*Cure of Rupture. By George Heaton, Boston, 1877.

†Op. Cit. p. 366.

℞ Fl. Ext. Querci Albæ (reduced
by distillation one half, ℥ ij.
Alcohol, 90 per cent. ℥ ss.
Ether Sulph., ʒ ij.
Morphia Sulphatis, grs. iv.
Tr. Veratri Viridis, M ʒ ij.

Inject from 5 to 20 drops in small and recent herniæ but 25 to 50 drops in old and larger herniæ.

Dr. Warren further modified the operation by injecting not into the sac, but "into the rings and around the sac." This he considers very important.

For a considerable time following the publications of Dr. Warren, the operation was done as he advised in various parts of America and in Europe. The exudations which supervene, as I have myself seen, are very considerable, the pain and suffering not great, the danger in competent hands slight, yet the results are certainly not as satisfactory as the profession was led to expect.

In the fourth volume of The Transactions of the American Medical Association, 1861, page 251, is a most interesting paper by Dr. Thomas Wood, of Cincinnati, upon the radical cure of hernia by a subcutaneous closure of the external ring by suture. "This is effected by a needle constructed for the purpose, curved so as to form about one-third of the circumference of a circle of two inches radius. It has two spear points with an eye in the centre of the shaft, large enough to admit a silk braid one-eighth of an inch wide." The sac is reduced, the finger carried

into the ring through the invaginated scrotum, and upon it the needle. The cord protected, the needle, as may easily be inferred from its construction, carries the suture, enclosing the ring in a loop, and the ends of the suture are brought out from opposite sides. These are tied over a compress and removed in from ten to fifteen days. Dr. Wood reports three operations followed by cure.

In submitting his paper to the profession, he states that he does it, "feeling confident that it will be appreciated according to its merits. If unsuccessful, it will be allowed a peaceful repose in the common sepulchre of its illustrious predecessors."

Dr. John Wood, of London, first published his method of subcutaneous operation by suture, in 1857. His experience is now probably greater than that of any other living operator, and his method, has been, and is, so extensively in use, that I copy from his most recent publication * his operation for the radical cure.

"This operation I consider to be the best for cases of perfectly reducible hernia, and especially for those in healthy children and young persons, in whom truss-pressure has been found to have no progress towards closing up the aperture, and particularly if they are likely to be called upon for a life's work, which will remove them far from instrumental and surgical assistance, or will render them incapable of

* International Encyclopœdia of Surgery, Vol. 5, p. 1140.

meeting the necessary and recurring expenses, while at the same time it will test and try their physical powers of resistance. It is also applicable to those in whom trusses fail in keeping up an increasing rupture, or cause, in some way or other, great discomfort to the wearer.

The patient being placed on the table, the parts shaved clean and purified, and an anæsthetic administered, so as to get the muscles relaxed, an oblique incision is made with a small, sharp-pointed tenotomy-knife, well washed in 1–20 carbolic lotion, in the front of the scrotum over the fundus of the rupture, three-quarters of an inch long, and through the skin and superficial fascia. The handle of the knife is then used to separate the integumentary tissues from the deeper fascial coverings of the hernia, or cord, so as to form a circle of detached integuments large enough to be invaginated into the hernial canal without drawing up the skin into the superficial ring. A stout handled needle, equally curved in the segment of a circle, with a sharp point, blunt shoulders, and a large eye near the point is used for carrying the wire. This should be well-annealed and flexible copper wire, silvered over, thick enough not to cut the tissues when drawn tight, but not so thick as to be at all inflexible. A piece about twenty inches long, briskly rubbed so as to render it flexible and clean, dipped in a 1–20 solution of carbolic lotion, and then in carbolized oil (1–5), should have each end bent into a hook three-quarters

of an inch long, and evenly curved so as to pass easily through the eye of the needle. The fore-finger, oiled, should then be passed into the scrotal puncture, and made to invaginate the fascia and sac into the hernial canal, as far as it will go into the deep ring behind the lower fibres of the internal oblique muscle, which should be raised well upon the finger. To the inner side of the finger will then be felt the raised edge of the conjoined tendon, lying on the outer side of the rectus abdominis muscle. The needle must now be carefully and slowly passed along the finger until its point can be felt plainly by the bulb of the digit placed behind the conjoined tendon. The point should next be directed inwards so as to take up the tendon, and to transfix it and the aponeurosis of the external oblique which covers it. Its point will then be seen to raise the skin. The skin must next be drawn towards the median line, and the needle directed by its stout handle so as to bring its point out through the skin, one inch and a half external to the puncture, through the deeper tissues. One end of the wire is then hooked on to the eye of the needle, and is drawn with it by a slight jerk through the tissues, emerging at the scrotal puncture. The needle is next detached from the wire and the finger again passed into the canal. Now the spermatic cord is to be felt for, lying in a groove formed by the union of Poupart's ligament with the fascia transversalis. The cord is to be pushed gently inwards, and the point of the finger

placed in the groove which it occupied, and lifted forwards, so as to elevate Poupart's ligament at its center, and with it the outer pillar of the superficial ring.

The iliac artery may be sometimes behind the finger, which lifts up the tendinous structure from its immediate contiguity, and protects the vessels from injury. The needle, passed again along the front of the finger, a little to its outer side, is then pushed through Poupart's ligament till its point raises the skin. The latter is now pulled inwards until the point of the needle can be made to pass through the same puncture in the skin of the groin which the wire already traverses. The opposite end of the wire is next hooked on to the needle, drawn down as before through the scrotal puncture, and then detached. There is now a wire loop at the groin, and two hook-ends at the scrotal puncture. Opposite the latter, the sac is then pinched up by the finger and thumb, in the same way that a varicocele is separated from the spermatic duct when submitted to operation. An assistant seizes it with finger and thumb, also in the same way, at about two inches distance, both assistant and operator recognizing the situation of the spermatic duct. The needle is then passed at one corner of the scrotal puncture across the sac, in front of the duct, and out at the other end of the scrotal puncture. The skin here is so elastic that the puncture stretches sufficiently to allow this to be easily done. The inner and of the wire—viz., that which traverses the con-

joined tendon—is next hooked on to the eye of the needle and drawn across behind the sac. Care must here be taken, by dealing with the wire roundly, not to make an acute bend or kink, which would put a needless difficulty in the way of its subsequent withdrawal. The wire should be drawn down so as to get straight parts in the tissues, and to bring the loop an inch or so from the skin surface. The two scrotal ends are then twisted twice or three times around each other, the operator observing the direction of the twist, so as to be able readily to untwist the wire when it is to be withdrawn. The loop of wire above is now seized and drawn firmly upwards, so as to invaginate the scrotal fascia into the hernial canal as high up as the deep hernial opening, and then it is twisted firmly down, in the same way and with the same precautions as the lower ends. The ends and loops are then bent over towards one another, the former cut off to a convenient length, passed through, and bent on to the latter. In very large cases, where the superficial ring is very patulous, the wires may be crossed in the canal, and the needle passed through the pillars near the pubis, after the sac is invaginated. Thus the lower opening of the hernial canal may be more effectively closed. In these cases a cylindrical pad of glass or boxwood may be used with advantage to secure the loop, and for the ends of the wire to be twisted over. A pad of lint, large enough to exercise compression, is fixed under

the bight of the double wire loop which has been formed, a little carbolized tow is put over the scrotal puncture to catch any discharge and a flannel spica bandage is applied, the ends of which, on being tied, should be made into a sling or suspender to support the whole of the scrotum and penis. The patient should be placed in bed with the shoulders well raised and the knees tied together and bent over a long bolster, with a prop for the feet to keep the body firm. The bowels should be opened on the morning of the operation, and then left until some discomfort is experienced. Opium should be given for the first twelve hours—one grain every four hours—until pain ceases or sleep comes on. The diet should be of milk and beef-tea, with ice to relieve any nausea left by the anæsthetic. No stimulants are advisable. The pain usually passes off in twelve hours. The discharge is trifling and of a serous character. The bandage rarely requires to be touched till three days have elapsed, when it may be removed entirely, with the pad of lint. A lump of well-teased antiseptic tow placed under the wire will be sufficient dressing. The scrotum should be well supported. In a few cases the urine may require removal by a catheter, for the first day or two, on account of the patient's inclination to contract the abdominal muscles. The wire should be kept in from eight to twelve days. according to the amount of reaction set up, the lower ends of the wire acting as an efficient drainage conductor. At the end of this time

the wire may be untwisted, and it will then be found that the two parallel, straight portions of the wire, which originally passed through different tracks, have by slow ulceration joined each other in the same track, and that they will come out together by cutting off their lower ends with pliers, and pulling upon the upper loop. If by reason of slight kinks there is any difficulty in this, the wire may be straightened by pulling at each end with pliers, and the ends may then be drawn together or singly. The upper opening usually closes soon after their withdrawal, and a truss may then be applied with cotton-wool beneath it, and the patient may be allowed to get up and lie on a couch until the lower sinus heals.

Sometimes a little swelling of the testicle, or effusion into the tunica vaginalis, shows that the spermatic cord is closely embraced by the wire, but this rarely calls for any special treatment, being entirely removed by the wire's withdrawal. In only one case, in which a steel clamp was used to hold the ends of the wire instead of twisting them, has atrophy of the testicle followed the operation. I have met with no burrowing of matter since substituting the wire for the hempen ligature and compress. The straightened wires act as efficient and cleanly drainage-conductors, aided by the raised position of the shoulders and trunk. Very little discharge is usually present throughout, and it only becomes purulent in the last few days. A large quantity of fibrinous effusion mats

together the walls of the canal with the inclosed, invaginated sac. The induration, however, soon disappears, and the cure depends, not upon its plug-like formation, but upon the adhesion of the hinder wall of conjoined tendon with the front wall and Poupart's ligament, adherent to and embracing the cord. The effect of this operation, when successfully accomplished, is to unite in one cicatrix the sides of the inguinal canal as far up as the deep ring, together with the pillars of the superficial ring, the union of which supports the invaginated, twisted, and obliterated sac, with its intimate coverings of external and internal spermatic and cremasteric fasciæ. All these are blended together in the fibrinous effusion consequent upon the gradual severance by the pressure of the wires. The conjoined tendon of the internal oblique and transversalis muscles is connected firmly with the deep part of Poupart's ligament, and upon this union depends, for the chief part, the success and permanence of the radical cure. Thus the valvular arrangement of the front and hinder walls of the canal is restored and strengthened by adhesion; and the rounded knuckle of bowel can no longer enter the deep ring, and thus, the most effectual preventive of the formation of a hernia in the healthy inguinal canal, is restored and even strengthened by the operation. Unless this is accomplished, the cure is not a satisfactory one; and one of the chief causes of failure in the hands of beginners is the want of dexterity and ex-

perience in obtaining a hold upon the conjoined tendon with the needle-point, at the first stage of the procedure.

In some cases, no doubt, a want of substance and development in the conjoined tendon causes it to give way before the needle, and to tear under the traction of the wire. In other cases, where the hernial rings are large in diameter and close to one another, with no length of canal between them—as in direct herniæ, and in old oblique herniæ which have become, in effect, direct, and in which a patch or plug of invaginated tissue is necessary to supply an absolute deficiency of the abdominal wall—the inherent weakness will require afterward, perhaps, a longer, or even the continued use of a light truss. If care be exercised, however, in placing and keeping on a proper truss, such cases may be strengthened and fortified, so that the rupture may not return, and even if the groin remains weak and bulgy, and threatens to reproduce a rupture, ultimate success may be obtained. And in another class of cases, doubtless, adhesions, at first firmly resisting and efficacious (if not deposited when the patient is in robust health), may yield, under continued pressure, just as in other cases of operation for prolapsus of various kinds. In less aggravated cases, the truss may usually be left off after nine or twelve months, the patient being at first careful to put it on occasionally, when likely to be called upon for much muscular effort.

A bulgy weakness of the groin may be apparent after the hernial canal is securely closed, from a want of development in the lower muscular and other fibres of the internal oblique and transversalis muscles; but this condition rarely requires more than the occasional use of a light truss, such as would be recommended for weak groins which had never been actually subject to hernia. When it is considered that in such cases, generally, no truss has been effectual in keeping up the rupture before the operation, the advantage gained by the latter becomes sufficiently convincing.

By the method just described I have operated upwards of two hundred times consecutively, with not a single seriously bad symptom occurring. The average period of convalescence has been about a month, from the operation to the healing of the lower opening; the average time in bed about eighteen days. Before adopting the use of the wire, thread and compresses were employed, and while the steps of the operation were imperfectly understood and carried out, and when, perhaps still more important, cases were operated on somewhat indiscriminately, to see what could really be accomplished, three deaths occurred in the first 100 cases; one from pyæmia, one from erysipelas, and the third from peritonitis, all having been published at the time in the medical journals. Two of these were decidedly from hospital or other infection, while the third case was a peculiar one; the necropsy clearly showed that fatal peritonitis

had been set up by a knuckle of intestine which had been involved in the sac before the operation, with the truss pressing upon it. The focus of inflammatory action was found around the damaged and congested loop of bowel, on the opposite side of the abdomen to that which was the seat of the rupture and of the operation. The sac operated on, and the peritoneum in its neighborhood, all around, were free from all traces or consequences of inflammation. In no case has any trouble arisen from hemorrhage, nor have there been any signs of injury to the epigastric, femoral, iliac, or other vessels."*

In the evolvment of thought in the same direction should be mentioned the operation by Dr. Agnew, of Philadelphia,† consisting in the use of an instrument for invagination, and then the subcutaneous sewing of the ring with wire. Three other sutures, also of wire, were used to enclose the canal.

The late Dr. Greensville Dowell, of Texas, devised a most interesting modification of subcutaneous suturing with interrupted silver wire sutures, using a needle in shape like that of Dr. Thomas Wood, of Cincinnati, but with an eye at each end, instead of the middle. The sutures were introduced in a manner not unlike that of Dr. Wood. He first published

* International Encyclopœdia of Surgery, Vol. V, p. 1140–1145.

† Medical and Surgical Reporter, Philadelphia, 1864–5, xii, 461, 3.

in 1866.* He advised from one to seven sutures, as required for firm closure. A little before his death he reported:† "The result of my operations, as far as I can learn, is about as follows: One hundred and three cases treated by myself; twenty-five cases partially relieved, two cases, as reported, made worse. One child died in seven days after operation, with congestion of the brain. Cures, seventy-six. So far as I know, all these remain well; some have had partial return of the hernia and worn trusses. Several were operated on twice and failed both times; I know no particular reason for the failure except the ligatures were put in too tight. * * * I simply put a piece of lint over the ligatures and saturate it with collodion." I knew Dr. Dowell, and greatly admired his inventive genius and fertility of resource. His operation has been performed by many of his associates with excellent result.

It will be noticed that, in the operations for subcutaneous suturing, the fundamental idea is not unlike the old, abandoned operations by the "punctum aureum," and suturing of the ring, in various ways, by the early fathers of surgery. To this, however, Dr. Wood brought correct anatomical knowledge and, by the manner of his suturing, sought to restore the obliquity or valve-like character of the canal. By the

* Medical Record, N. Y., Vol. I, p. 266.

† Warren, Op. Cit., p. 113.

rare tact and experience of the master, he secured better results, than any operator preceding him; much better indeed than his followers. Dr. David W. Cheever, of Boston, Surgeon City Hospital, in 1870, reported twenty-four cases, operated on for cure, with two deaths. In commenting upon the operation, he writes, " Hernia has long been one of the *opprobria* of surgery. To cure it no operation is certain. The operation of Mr. Wood seems the most reasonable one proposed. It will cure a certain number of children and young adults. It will fail to cure others. Mr. Wood, it must be remembered, claims some 70 per cent. of success. We can show barely 25 per cent."

* " During the past five years, herniotomy has been performed twenty-six times for strangulated or irreducible hernia. Thirteen ruptures were inguinal, six died; twelve femoral, five died; one umbilical, died.

Of eleven patients over fifty years of age only two recovered; while of fifteen under that age, twelve resulted favorably. The average duration of convalescence was about a month; in the fatal cases death resulted at periods varying from five hours to eighteen days; about five days being the mean duration of life. The cause of death, so far as could be determined, was as follows: Exhaustion, six; peritonitis,

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* Medical and Surgical Reports of City Hospital, Boston, 1882, p. 267, 271. G. W. Gay, M. D.

four; tetanus, one; erysipelas, one; total, twelve, out of twenty-six operations."

"Twelve patients suffering from inguinal rupture were operated upon for a radical cure. Wood's method was resorted to in four instances, with temporary relief. The so-called Heaton operation was performed eight times; six cases were partially successful, and two were complete failures. All of these patients left the hospital wearing a truss or bandage, and their subsequent condition is unknown. No radical operation has been performed upon any of the other varieties of hernia during the past five years."

We have ventured to give here a brief account of our personal experience with the Heaton operation, and have recorded *all* the cases operated on by us, both in hospital and private practice; the results are stated as fully as possible. All were cases of inguinal hernia, and with the exception of those specified, were supposed to contain intestine. Only those patients are called *cured*, who have remained well for at least a year after discarding all support to the rupture."

"Number of patients, fifteen. Cured, four. Relieved, eight. Not relieved, three.

Number of ruptures, eighteen. Cured, five. Relieved, eight. Not relieved, five.

Number of operations, twenty-three."

The criticisms, which I think we are now in the condition to make, owing to the safety of properly treated operative wounds, is that subcutaneous surgery

is blind surgery and blind surgery is, as a rule, bad surgery. A subcutaneous wound is better by being such, only that it is less liable to be, or to become, an infected wound. The problem of hernia as we have endeavored to show, by the careful study of the anatomy of the parts and the formation of the peritoneal sac, is one containing factors which necessitate treatment by an open wound, in order to furnish the highest measures of resultant cure. The peritoneal sac is a redundancy of extraneous tissue and should be treated as a factor to be eliminated. This has been the stumbling-block in the surgical treatment of hernia, during the centuries, often recognized as such, but because of the generally occurring septic infection of open wounds, and high mortality when in this locality, considered of unwarranted danger. This is one of the fundamental faults in the treatment of hernia by the injection, and by the subcutaneous suturing of the ring. In both the above methods, also, there is an attempt to fill the ring by material, foreign to its primary construction. In the first, by a large exudate, often incorporating the sac;—in the second, when the sac is completely returned, by a portion of the spermatic fascia. Experience had long ago taught, that the complete closure of the canal and rings gave much the better result. It was in recognition of this, that castration became, for a long time, the adopted method and continued so, until prohibited by law, not because the hernia failed of cure, so much as that a consider-

able class suffered loss of virility, a choice of evils, which many voluntarily made, when all surgery, at the best, was brutal, as compared with the present.

Mr. Wood, by his subcutaneous wire suture, can make at the most only two stitches, one to enclose the internal, and one the external ring, yet Mr. Wood recognized the necessity of close approximation and writes, "to ensure success, complete union must be established along the whole length of the canal." Drs. Agnew and Dowell increased the number of stitches in order the better to secure this result. In part, also, to remedy this fault, the very interesting modification of Mr. Wood's operation was devised, namely, the extremely ingenious and original instrument by Mr. Spanton † whose good work, as an operator, in England is well known. The cork-screw instrument is at once needle and suture and is to be commended for its advantages over the so-called Wood suture.

The methods above described are marked improvements upon preceding operations for the cure of hernia. These improvements, however, are but modifications of the general idea which we have seen dominated the profession for centuries; to close the canal by some sub-cutaneous method, through the fear, born of experience, of the dangers incident to septic infections of the locality. Such fatality was

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† D. W. Spanton, British Med. Jour., Lond. 11, p. 322, 1879.

quite sufficient to justify the general opinion, and it required a large amount of the heroism of conviction to put into execution, in operations undertaken for the cure of hernia, the methods of antiseptic wound treatment.

CHAPTER X.

THE OPERATION FOR THE CURE OF HERNIA BY THE OPEN WOUND METHOD UNDER ANTISEPTIC PROTECTION.

The revolution in the surgical treatment of wounds had its inception with Sir Joseph Lister, whose marvellous genius and indefatigable industry surmounted all obstacles.

His inspiration came from the studies of Pasteur and others, including our own Professor Jeffreys Wyman, upon fermentation and its dependence upon vital, rather than chemical causes. The results of his labors, for the benefit of his race, have never been exceeded by any devotee to the healing art, and his name must be indissolubly associated with the treatment of wounds, so long as surgery remains a branch of science. By rare good fortune I received his personal instruction at Edinburgh, in 1870. The demonstration seemed complete that in an aseptic wound thus retained, repair goes on under the same favorable conditions as in subcutaneous wounds. The factors in the problem to be solved were, the best methods of preventing contamination in the wound when open, and retaining it uninfected during the process of repair. In all operative measures, the ligation of the larger arteries is often an important consideration. As done during the earlier part of

Mr. Lister's investigations, it was so defective, that often about the ligature dangerous processes supervened. In the research for better material for ligatures, Mr. Lister experimented with the strings of the violin. Satisfied, that in carbolic acid, he had found a safe and comparatively non-irritating agent for the protection of the open wound, he made application of it for the better preparation of ligatures. Its effects upon the catgut when steeped in it appeared to change its constituency so as not only to render it innocuous in wounds, but when incorporated in the tissues, for a considerable period, to resist maceration. Happy in the knowledge of such facts, Mr. Lister instituted a series of experiments in the ligation of the larger vessels in animals and found that when aseptically applied they were in considerable measure replaced by a vivified connective tissue.

Upon the 19th of February, 1871, in consultation with Dr. A. P. Clarke, of Cambridge, I operated upon Mrs. M., aged 50, who, for years, had suffered from hernia. Five days before, she was seized with severe pain in the inguinal region, accompanied by vomiting. Long-continued and careful taxis had failed to reduce the hernia, and for twenty-four hours the vomiting had been stercoraceous, and the patient seemed in extremis. The hernial tumor was of the size of an egg, protruding from the external inguinal ring. A careful dissection exposed the sac, which was closely adherent to the surrounding parts. The constriction

was at the internal ring and was divided with some difficulty. The hernia was reduced and the sac, unopened, was returned within the ring. Two stitches of medium-sized catgut were taken directly through the pillars of the ring.

The wound was dressed antiseptically, and from Dr. Clarke's notes, taken at the time, I find that the patient complained of no pain, steadily progressed without accident, and was convalescent in three weeks. The result was a radical cure of the hernia, although the canal was not closed for this purpose. The opening into the abdomen was so large that we feared the escape of contents, especially since the woman was afflicted with a severe chronic bronchitis. It was expected that the sutures would hold the parts in situ temporarily. She died six years after the operation, and was troubled with the cough during the entire period, but the canal remained firmly closed at death. She did not wear a truss after the operation.

March 10, 1871, assisted by Dr. W. W. Wellington, of Cambridge, I operated on Mrs. L—, aged 45, suffering with strangulated hernia. The hernia was of some years' standing, and usually retained by a truss. It was on the left side and direct inguinal in variety. The sac was returned unopened, the canal was closed by three large sized cat-gut sutures, taken deeply through the pillars of the ring, and the wound carefully dressed antiseptically with Lister's carbolized

lac plaster. When examined the following June, the cicatrix was linear, and a firm deposit of new tissue could be felt, marking the site of the buried sutures. The cure remained permanent, and the patient wore no support.

I reported these cases at the meeting of the County Medical Society, October 11, 1871, and they were published in the Boston Medical and Surgical Journal, November 16, 1871, under the title, "A New Use of Carbolized Cat-gut." In closing, I remarked: "As far as my observation has extended, this is a new use of the carbolized cat-gut ligature, and suggests a still wider field of application. No method of operation for the radical cure of hernia appears more feasible, is probably attended with less danger, and, at the same time, affords a means of closing and strengthening the weakened ring, which is so desirable, and yet, with all the ingenious devices of surgery, is so difficult to obtain." *

A thoughtful observer could not help profiting by results of such value. After a review of Mr. Lister's studies upon the cat-gut ligature, as applied to the constriction of arteries in continuity, I instituted a series of experiments on animals, with careful histological studies upon the changes which animal sutures, cat-gut and the tendons of animals undergo when buried in the tissues.

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* Boston Medical and Surgical Journal, Vol. viii, p. 316.

Upon these facts and deductions so fundamental, I determined that, about the site of the suture, there results a deposition of connective tissue cells, which in a considerable measure replace, almost cell by cell, the dead, aseptically preserved tissue, by a living, vascular growth.

These changes varied, dependant upon the condition of the incorporated part. If the suture or wound is septic, the conditions, then called inflammatory, ensue, the tissues become reddened and swollen, leucocytes are poured out along the tract of the suture and abscesses result. If aseptic, and yet not chemically changed, to prevent rapid maceration, the threads speedily disappear with only a moderate exudate, which is soon absorbed. If more resisting, the ensuing changes go on more slowly with much greater cell infiltration. There is found to be a limit of apparently a chemical change in the fibres of the suture, beyond which the softening goes on too slowly, and sometimes a part, especially a knot, is eliminated as a foreign body.

The considerable supply of cat-gut, which I brought with me from Europe, was made under the immediate supervision of Mr. Lister and kept perfectly. Subsequently, I prepared the catgut and tendon sutures which I used after his formula.

It is probable that the honor of first, in modern times, putting animal ligatures to the test in surgery, is due to the late Dr. Physick, of Philadelphia,

although Dr. Thomas Young, of Edinburgh, in his "Introduction to Medical Literature," published in 1813, wrote, "I have often wished to try ligatures of cat-gut which might be absorbed."

Dr. Physick made his ligatures of Chamois skin.

The immortal McDowell who first performed ovariotomy, ligatured the pedicle with narrow strips of Indian tanned deer skin, and returned the stump within the abdominal cavity. Dr. Paul Eve, of Tennessee is attributed to have used similar ligatures and also those made of the dried tendon of the deer.

Illustrating the old maxim, that "there is no new thing under the sun," we read the teachings of to-day, in the Arabic works of the celebrated Rhazes who practiced in Bagdad, A. D. 900; and again, a century or more later, in Albucassis who wrote of the closing of abdominal wounds with lute strings, and of the stitching together of wounded bowels with fine threads, made from the intestines of the sheep. Homer, in the Odyssey, states that the harp-strings of the Greeks were thus made. In similar manner also was strung the harp of the ancient Egyptians, and it is very probable cat-gut ligatures and sutures were not unknown at the time of the Pharaohs.

A considerable number of our best surgeons condemned cat-gut, after a few trials, because of unsatisfactory results. Reports of failure in the cure of hernia on account of too speedy absorption were made to me as early as 1876. Believing this must be from

faulty material, if aseptically applied, I entered upon an extended research, intending to cover the entire field of animal sutures.

The cat-gut prepared in Italy is deservedly most highly prized by musicians. This is made from the mountain sheep, more active and less fat than ordinary domestic sheep. The connective sheath of the intestine is, on this account, less fatty and stronger; yet in the process of manufacture it is split into ribbon-shaped pieces, closely twisted, and after drying, is often sandpapered to give an even surface, and by thus cutting, it is much weakened. These processes greatly injure the product for surgical purposes. Many specimens examined, after maceration, show, in the cross cutting of the fibres and irregular edges, good cause for yielding in the tissues, although capable of high tension in the dry state. The long maceration which the intestine has to undergo in the preparation for the separation of the connective tissue sheath is also productive of injury. In this state the entire mass is usually in a condition of active putrefaction for some days, and infective material may remain in it through its subsequent stages of preparation.

The parallel bands of connective tissue which make up the tendons of animals came naturally to be considered as furnishing suitable material for surgical purposes. In the dried state, these were used to some extent a generation ago. I obtained excellent speci-

mens in quantity, two feet long, from the tendons of the hind leg of the moose and caribou of Northern Maine. They divide into comparatively fine threads and are chromicized. I found the tendons from the tail of the whale, although often four feet in length, fatty and liable to fray. Upon the western plains I was taught by the Indians the way the women use the fascia lata of the buffalo in sewing skins. These also proved not well suited for surgical use.

In 1880, Dr. P. G. Simmons, of Charleston, S. C., sent me fine specimens of tendons from the tail of the large southern fox squirrel, which he had used with much satisfaction. They were perfection, except in length. Knowing that a similar long tendon extended through the tail of the kangaroo, I sent to Australia and obtained a supply from the hunters in 1882. These proved all that could be desired, and I have used them constantly since, and for sutures and ligatures consider them in every way superior to any other material. I have fine specimens of the spun fibre from whale tendons, prepared in Japan, and, somewhat recently, am indebted to a medical gentleman of Russia for some excellent sutures made in this way from the tendon of the reindeer.

Although I had continued to operate, from time to time, as occasion demanded, upon cases of strangulated hernia, and in each case had closed the ring with continuous buried animal sutures, it was not until February 4, 1878, that I deliberately attempted

a cure for a reducible hernia. This patient I had, some time previous (Dec. 2, 1877), cured of a large old irreducible omental hernia which had become complicated by a strangulated loop of intestine. In this instance, I dissected the sac and resected the omentum. I closed the neck of the sac with a continuous cat-gut suture, excised the sac, and returned before suturing the ring.

A truss retained imperfectly a large direct inguinal hernia of the left side, for which she besought cure, although seventy years of age. I was aided by Dr. A. L. Norris, of Cambridge, who cheerfully gave me his approval. In this I was the more fortunate, since until that time my advocacy of operative measures for the cure of hernia, in non-strangulated cases, had not met with approval. The operation was not difficult and the result satisfactory. On the 17th of April following, she died of an aneurysmal tumor of the brain. The autopsy gave me two excellent specimens of different dates, showing not only the histological changes which ensued about the suturing, but the conditions of the underlying peritoneum. In the first operation, where the sac had been sutured and resected before closure of the ring, the peritoneum was perfectly smooth and without depression, at the former site of the ring. Upon the opposite side, where the sac had been returned unopened, there remained a little pouched depression of peritoneum, which taught the ease of reformation of

hernia. These specimens, I presented to the American Medical Association, at the annual meeting held in June, and communicated, at considerable length, my views of the operation for the cure of hernia, by the buried animal suture.*

I gave in this paper, the history of the animal suture and its preparation for surgical uses, since few surgeons at that date, even in England used cat-gut for the ligation of vessels.

In a farther communication upon the cure of hernia, to the International Medical Congress, held in London, 1881, I emphasized the freeing of the sac, and its resection, after sewing it across at its base with a continuous animal suture, and then refreshing the pillars of the ring, and closing by deep buried continuous sutures of tendon, which are much to be preferred to cat-gut. I summarized the advantages of this method of operation as follows:

"I. We are enabled to see clearly each and every step of the operation; blind surgery is bad surgery, as a rule.

II. It is the only method with which I am acquainted by which the hypertrophied, elongated, peritoneal pouch, which has been a primal factor of failure, hitherto, can be removed.

III. Hereby, we actually reinforce, as well as occlude the ring. In the weakened, attenuated con-

* Trans. American Medical Association, vol. 29, 1878.

dition of the parts, in all old cases, there is no small gain in securing such effect.

IV. Experience has, I think, now demonstrated that this operation may be catalogued among those safely advised, and that femoral and umbilical hernia are no exceptions. I would not exclude children from the class to be benefited for in them the vital processes are at the best, and when thus cured they are saved from a life-long disability."*

In May, 1886, I contributed to the American Medical Association a further report upon, "The Radical Cure of Hernia," based upon a series of thirty operations, in which I show that in my hands the operation, as such, has been devoid of danger. I conclude the paper by recommending the advisability of the operation by the buried tendon suture after resection and closure of the sac,

"I. In all cases of operation for strangulation.

II. In all cases where the abdominal contents are imperfectly retained by an instrument, unless the age and condition of the patient prevent.

III. In the large class of children, when the conditions do not promise a spontaneous cure.†"

The first case, of which I find record, after my

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*Trans. International Med. Congress, Vol. ii, p. 446.

†Journal American Medical Association, May 28, 1887.

own, where the canal was closed by animal sutures, is that by Mr. Charles Steele, of Bristol, England, May, 1873. The operation was performed on a boy of eight years, and the canal closed by two catgut sutures. The recovery was rapid and the boy remained for six months cured, when strangulation occurred, and the operation was repeated with three sutures. The recovery was perfect and a truss applied. When reported the cure remained, and the parts were firm."

Mr. Steele says: "While I thought out and performed this operation, as an original matter, I do not assert that I originated the operation; in fact, it seems to me the most likely measure to suggest itself to any surgeon's mind when considering the subject, and I dare say several have performed it.*"

Prof. Thomas Annandale,† of Edinburgh, operated upon a case of strangulated femoral hernia, in January, 1872, in which he tied the neck of the sac with catgut, and removed it with some adherent omentum. The result was so satisfactory that Mr. Annandale states: "I have adopted this method, in all cases, since operated on; but during the last two years, I have, in addition, stitched the margins of the abdominal opening together." He commends unhesitatingly, "ligature of the neck of the sac, with excision of the sac, and stitching together the margins of

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*British Medical Journal, Nov. 7, 1874, p. 584.

†Edinburgh Med. Jour. Dec., 1880.

the abdominal opening." He uses catgut and Listerian antiseptics.

To Prof Czerny,* of Heidelberg, is accredited the origin of the operation by the open method, for the radical cure of hernia, in Germany. His first case was a strangulated hernia, of a child, two and a half years old, operated on, October 21, 1877.

The canal was closed by two sutures of silk.

The wound became septic with abscess, but the cure was complete two years later. There are reported nineteen radical operations upon sixteen patients. Complete ligation of the neck of the sac was made in nine cases. Suppuration supervened thirteen times. Silk was used as suture. The canal was closed in four cases.

Schede's† first case of operation for cure was a double, reducible, inguinal hernia which, in consequence of the large size of the rings, could not be retained by a truss.

The operation was performed by freeing the sac, drawing it down as far as possible, ligating it at the neck, and resecting. On one side, a piece of omentum was included in the ligature and removed.

The cure was complete, although the rings were previously large enough to admit three fingers.

He reported in connection a series of eight cases,

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* Berlin Klin. Wochenschr. No. 4, 1881.

† Max Schede Centralblatt für Chirurgie Nov. 1877.

THE BURNETT SANITARIUM COLLECTION

the primary operation in all was the obliteration of the sac. The character of the ligature is not mentioned. He states the difficulty of applying a perfect antiseptic dressing in this region of the body is very great, on account of atmospheric contamination and the contact of urine, especially in children. Also he gives the opinion as to the final result that, in the majority of cases, the operation can only be expected to put the patient, in such a state, that the wearing of a truss will prevent the future prolapse of the hernia.*

The interesting monograph of Victor Cuénod † gives the work of Professor Socin, in the hospital at Basle, from 1877 to 1881, in the operations for the cure of hernia.

The results are so interesting and important that I append a brief abstract.

Prof. Socin, having carefully disinfected the parts, and the bowel having been properly emptied, by means of mild purgatives, if necessary, proceeds as follows:

1st. Incision of skin and subjacent tissues as far as the sac.

2d. Dissection and isolation of the sac, effected by soft instruments or with the finger; if this dissec-

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* Berlin Klin. Wochen. Schr. No. 4, 1881.

† Étude Du Résultat Définitif dans la Cure Radicale Des Hernies. Victor Cuénod. 1881.

tion is not possible, preparation of the neck so as to be able to constrict it.

3d. Incision of sac, reduction of its contents, after freeing the constricted ring, if it is a strangulated hernia, if necessary, resection of the adherent omentum.

4th. Simple ligature, double, triple, or quadruple of the neck, carried as high as possible, and excision of the sac.

5th. Suture of the pillars, when it is necessary.

Finally, the aponeurosis which covers the sac is often brought together with sutures, the cavity is drained, disinfected, and the edges of the skin are united by sutures. A Lister dressing, very carefully applied and well compressed covers the wound.

Monsieur Socin considers it useless to refresh the edges of the ring, and has not practiced it upon the cases here reported. It is only rarely, in cases of inguinal hernia, that he sutures the ring. In one or two cases of crural hernia, with a large opening he has found it necessary to bring together the borders of the orifice, in order to secure occlusion.

Finally in inguinal hernia, the presence of the spermatic cord is one of the most serious obstacles to the complete success of the operation. It is evident that complete obliteration of the hernial canal will be more diffcult, since the surgeon is obliged to leave in this canal a moveable organ, subject to difference in size and frequent movements. In women, the pre-

sence of the round ligament is of much less importance and needs to be considered only in pregnancy and delivery.

It is doubtless owing to these anatomical conditions that we must attribute the difference in results obtained between inguinal and crural hernia. In the first, the passage of the hernia is made through a canal already formed which can be only narrowed and not completely obliterated after the operation, while in the second, this passage is made through a simple orifice, of which the complete occlusion will be much easier to secure.

Report of his cases from 1877 to 1880 which were operated upon in the Hospital at Bàle.

"Sur 17 hernies non-incarcérées, il y avait 15 hernies inguinales et 2 crurales.

Sur 17 hernies incarcérées, il y avait 10 hernies inguinales et 7 crurales, giving as result:

Sur 17 hernies non-incarcérées, 9 relapses, 8 cures.
Sur 17 hernies incarcérées, 3 relapses, 14 cures.

Or more exactly:

Sur 15 hernies inguinales non-incarcérées, 9 relapses, 6 cures.
Sur 2 hernies crurales non-incarcérées, 0 relapses, 2 cures.
Sur 10 hernies inguinales incarcérées, 1 relapse, 9 cures.
Sur 7 hernies crurales incrarcérées, 2 relapses, 5 cures.

This gives, as percentum, in classes:

For non-incarcerated hernia, 52.9 per cent. relapses, 47.1 per cent. cures.

For incarcerated hernia, 17.6 per cent. relapses, 82.3 per cent. cures.

And in varieties:

Inguinal non-incarcerated, 60 per cent. relapses, 40 per cent. cures.

Crural non-incarcerates, 60 per cent. relapses, 100 per cent. cures.

Inguinal incarcerated, 10 per cent. relapses, 90 per cent. cures.

Crural incarcerated, 18.5 per cent. relapses, 71 per cent. cures.

These cases had all been heard from as to their condition from nine to forty-three months after the healing of the wound.

Of the twenty-two cures, eight were males, fourteen females; as to age, as follows:

AGE OF PATIENTS.	PATIENTS CURED.	CASES OPERATED UPON.
1—10 years.	2	2
10—15 "	1	1
15—20 "	2	2
20—30 "	1	3
30—40 "	3	7
40—50 "	5	5
50—60 "	5	11
60—70 "	2	2
70—80 "	1	1

Conclusions:

" 1. The result of so-called radical cure can be

considered definite, only about two years after the operation.

2. The chances of success exceeding greatly non-success in children, the radical operation is indicated, with this class, always where the hernia cannot be retained with a bandage.

3. The radical operation is indicated in adults and aged persons, in all cases where a bandage cannot be supported or efficacious in its action.

4. The ablation of the sac and suture of the neck in no way complicates the operation of kelotomy, but increases, on the contrary, the chances of success of the operation, and should always be practiced in strangulated hernia."

M. Tilanus reported to the Congress, held at Amsterdam, in 1879, a statistical paper upon the antiseptic operations performed for the cure of hernia. He collected reports of about one hundred cases, by different surgeons, with only eleven per cent. of cures. He advised excision of the sac and deep sutures.

M. Championnière, of Paris, in 1880, recommended the excision of the sack with scarification of the neck and deep sutures; sometimes a retaining suture of silver.

Mr. W. Mitchell Banks,* of Liverpool, contributed an article, in 1882, upon the radical cure of hernia by the removal of the sac, and the stitching together the

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* British Medical Journal, London, 1882, p. 985–8.

pillars of the ring. His first reported operation was in January, 1880.

In August, 1887, at the meeting of the British Medical Association, Mr. Banks reported a tabulated list of 106 cases with an analysis.* Sixty-eight cases were without strangulation; in 38 strangulation was present. "The operation which I have adopted is this: In inguinal hernia, the sac, after being cleanly dissected out, is opened, and all bowel is replaced, and adherent omentum tied, and cut away. The sac is then well pulled down, ligatured as high up in the canal as possible, and removed. Finally, the pillars of the ring are brought together by two or three silver ligatures, which are left in position.

In femoral hernia, the cleaning and removal of the sac constitutes the whole operation, and no attempt is made to close the femoral aperture. In ventral and umbilical hernia, use is frequently made of the whole or part of the sac, as a kind of plug to stop the aperture, which is generally large, and in which it is seldom possible to adopt any means of approximating the edges which seem likely to be permanent."

In the analysis of his tables Mr. Banks states "that in the sixty-six cases which he has been able to follow up, forty-four were completely successful from a curative point of view." Mr. Banks does not consider the truss such a serious inconvenience, and would

* British Medical Journal, August 10, 1887, p. 1259–61.

not operate where the rupture could be retained. He also "advises everybody to wear a light support after operation." "All parings, scrapings and freshenings of the inguinal canal I hold to be utter nonsense, and quite theoretical. When an inguinal hernia is big enough to warrant operation, there is commonly little canal or ring left. I have generally found a big hole with a thin-edged margin, which has taken three or four fingers of an assistant to plug up, while the sac was being removed. Then what is the use of pulling the pillars together by sutures? I do it simply to hold the parts together temporarily while the wound heals, so as to prevent all danger from coughing or straining, because in very big operations I leave the wounds quite open."

Mr. Banks would rarely operate in children, having done it only four times in the entire series.

Mr. Kendal Franks,* of Dublin, first operated in 1882. Reports 24 cases done under strict antiseptic precautions.

"What I have most frequently done, is to clear the sac from surrounding parts, then to open it and pass my finger through it till I can feel the margins of the internal ring. I then pass the silver wire, first through one pillar of the ring and through one side of the sac, then passing the needle through the other

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* British Medical Journal, London, Dec. 3d, 1887, p. 1202–4

pillar of the ring, and through the other side of the sac, I thread it with the same wire and withdraw it. When this suture is fastened, it not only closes the ring, but fixes the sac between its pillars in such a way as to obliterate its cavity. Two wires are generally used for this purpose. Below the sutures the sac is excised.

"I always use buried sutures, that is, I endeavor to sew together with cat-gut the various layers of tissue which have been divided. The skin wound I bring together with an oblique suture, so as to leave a slight pucker at the upper angle for drainage. By so doing a drainage tube is seldom required, and the first dressing is allowed to remain undisturbed for ten days. I generally find the wound perfectly healed and the dressings caked and dry.

"I first close the upper part of the internal ring by passing the silver wire straight through the aponeurosis of the external oblique directly over the internal ring. The needle point is, of course, protected by a finger passed through the canal, and pressing the abdominal wall forwards at this place. The needle armed with the wire then picks up part of Poupart's ligament, and, having reached the finger, is carefully made to appear through the canal, when the wire is caught and the needle withdrawn. The unarmed needle now passes through the external oblique aponeurosis, as before, and at a point corresponding to the other side of the ring, passes through this pillar,

and being brought out through the canal, it is threaded with the wire and withdrawn. Before this suture is twisted, a second one is passed at the lower end of the ring in the same manner. This second suture corresponds generally to about the middle point of the canal. It also passes through the aponeurosis of the external oblique immediately in front of the lower part of the ring. The third suture, which is also generally silver, closes the external ring. This I believe an immense improvement."

All cases operated on by Mr. Franks easily recovered, and at time of report, only four cases were known to have failed, and these were much improved. "In competent hands where every precaution is taken against avoidable danger, the operation is believed to be eminently a safe one."

Mr. Arthur Barker,* reports 35 cases of hernia operation, done at the University College Hospital, under antiseptic precautions, with rapid recovery. His method consists in a partial resection of the sac and the closure of the canal by interrupted silk sutures, six or seven in number. These are cut short and left buried, no drainage as a rule. Dressing antiseptic, salicylic wool.

Mr. A. W. Robinson,† of Leeds, England, tabulates twenty-six cases. In all but two cases, where Wood's

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*British Med. Jour., London, Dec. 3, 1887, p. 1204.

†British Med. Jour., Dec. 17, 1887, p. 1324.

operation was performed, the sac was excised after its neck had been ligatured, the canal being sutured, only when very open. Strict Listerism was followed in every case. He recommends ligature of the sac and suture of the pillars of the ring.

Mr. Chauncy Puzey,* of Liverpool, reports twenty-four cases of operation by the open aseptic method. The first, in 1881. He emphasizes the dissection of the sac and its ligation as far up as possible and removal; suture of the pillars with stout chromicized cat-gut. Thinks wire should not be employed. So far as known there has been no failure and all made rapid recoveries.

Mr. Christopher Heath,† of London, reports six operative cases, two of extroverted bladder, one death. Advises resection of sac, with deep cat-gut sutures, aseptically applied.

Mr. C. B. Keetley,‡ London, contributes an interesting article upon "the radical cure of hernia by open injections," and in summing up states, "I believe that a thorough operation of combined excision, ligature, and suture will almost certainly effect a lasting cure. The dangers are often considerable, but they belong to the operator rather than the operation and are avoided by care and experience. The injection

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*British Med. Jour., London, Dec. 17, 1887, p 1327

†British Med. Jour., London, May 23, 1885, p. 1041.

‡British Med. Jour., Dec. 3, 1887, p. 1205.

is at present uncertain as to result, but it is pre-eminently simple and safe."

Mr. F. Treves,* of London, and Mr. G. A. Wright,† of Manchester, have presented most interesting communications upon hernia of the cœcum. Mr. Treves reports two and Mr. Wright five cases. The operations are given in detail with a review of the subject. The sac was tied and resected and the canal closed under antiseptic care.

Mr. A. Rabagliati,‡ of the Bradford Infirmary, reports, at some length, the results of his experience. He advocates the removal of the sac, stitching the edges of the peritoneum by fine cat-gut sutures, as in ovariotomy. The pillars of the ring are closed by a second line of sutures, and then the skin. The operation is done under antiseptic precautions. He reports ten successful cases treated by removal of the sac.

Mr. John Wood is to be commended in the changing of his methods, under the conviction that antiseptic measures allow of better results.

In the discussion of Mr. MacCormac's address upon Antiseptic Surgery, in December, 1879,§ Mr. Wood stated, "in cases of large scrotal hernia, in

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* British Medieal Jeurnal, February 19, 1887, p. 384.

† British Medical Journal, March 5, 1887, p. 506.

‡ British Medical Journal, December 3, 1887, p. 1206.

§ Wm. MacCormac, Antiseptic Surgery, London, 1880, p. 74.

which trusses are of no avail, and the sac is much thickened, of great size, and sometimes presenting constrictions in its substance which are a source of great danger from strangulation,—the spray and gauze dressing, with the cleanliness and freedom from contamination, putrefaction, and suppuration, which it affords, has enabled me to extend materially the scope of benefits to be derived from the operation for the cure of hernia. In such cases, I have removed the whole sac, and sometimes coherent omentum, through an incision in the scrotum two and a half inches long, stitched up the peritoneal orifice with a continuous suture of strong carbolized cat-gut, and then I have drawn together the tendinous sides of the hernial opening, with thick silver wire, to resist the tendency of the intestine to protrude and force through the cat-gut suture (which is too weak to support the strain when unaided by such support, and becomes speedily absorbed). A drainage tube carried through the bottom of the wound and along the wire enabled me to keep the wonnd perfectly clean of accumulation and retention of discharges." In Mr. Wood's lectures upon "Hernia and its Radical Cure," delivered at the Royal College of Surgeons, in 1885, and published in the British Medical Journal, during June, he writes: "In the case of tendon ligature being used, it is now to be braced up tightly, tied in a well-secured surgeon's knot, cut off close and buried in the wound." * * * In the case of tendon being used, a drain-

age tube should be placed, reaching from the superficial ring into the scrotal puncture and the gauze dressing applied, in the usual way, by a double spica bandage, with a piece of jacquenette, through which the penis is passed, placed over all to keep off urine from the absorbent dressing."

In twenty-eight cases operated on by the open method with antiseptic precautions, the sac was tied at the neck with separate stout catgut and removed, the canal and rings were closed by sutures of kangaroo, or ox tendon, or wire.

Of the series, there were three deaths, but all from inflammations of the lung in bad subjects.

In the discussion of femoral hernia he writes: "Latterly I have found the use of tendon ligature so satisfactory, that for this operation I prefer it to wire. The wound usually closes over it and heals by adhesion at once, and there is not the pain and inconvenience of the withdrawal of the wire. So far the endurance of the tendon, when buried in the tissues, has been long and satisfactory enough to maintain the cure, which has been watched, noted in some cases for about two years."

His method of suturing is to transfix the sac with a stout tendon carried through it by a needle with eye near the point, tie on each side and cut the sac close. In a deep suture, he closes the femoral ring with the same tendon and leaves it as a buried suture; uses here drainage as in the inguinal variety. He re-

ports to have operated sixteen times for strangulated hernia—eight inguinal and eight crural—with attempt to secure a cure. "Seven were done by ligature of the neck by catgut and entire removal of the sac, with the closure of the canal and rings by wire lacing, and nine by the use of tendon for all these purposes."

Mr. Wood reports, "one case of radical cure of umbilical hernia. With respect to the supposed advantages of the open method, enabling the surgeon to see the parts on which he operates, I have myself found that, after the first cut and the application of the sponge, the parts become so bleared with blood, that I was obliged to rely mainly upon the aid of the sense of touch, before I ventured to pass a needle through Poupart's ligament, the conjoined tendon, or the pillars of the ring."

In conclusion, Mr. Wood writes: "It appears indubitable from the results of the last twenty years' experience of the radical cure of hernia, that the position of those surgical writers, who have maintained that the radical cure should not be attempted, except in the severest cases, is untenable. The operation has given as great relief and exemption from the minor troubles and worry which make life miserable as any operation associated with prolapse, such as hemorrhoids, and is even more safe."

Mr. James Hardie,* of Manchester, England, in

*Braithwaite's Retrospect, vol, xcii, p. 122.

a paper published in 1885, gives the results of an extended experience of operation by the open method. He emphasizes the liability of the hernia returning by a depression in the peritoneal pouch, and recommends the taking of the sutures through the neck of the sac, so as to include quite a border of the transversalis fascia. This with him is all the more important since he leaves the sac, having introduced into the lower end of it a drainage tube. He uses wire to close the canal.

Mr. Clement Lucas,* emphasizes the removal of the sac as of itself always to be considered a source of danger. "To rid the patient of this abnormal, overstrained, ill-nourished, not only useless, but absolutely injurious piece of tissue, should be the aim of every surgeon when called upon to operate for strangulation, after reducing the bowel. It is probable the only operation for radical cure that will stand the test of time. I regard no operation for femoral hernia complete, till the sac has been excised, even although the bowel may have been reduced before the opening of the sac. The same may be said of acquired congenital hernia. The congenital inguinal presents especial difficulties, as the whole sac cannot be excised without sacrificing the testicle; but I usually excise the funicular portion, and rigid antisepsis is here advisable." Dr. Lucas also reports two very interesting

*British Med. Jour., Oct., 1885.

cases of cure of large umbilical hernia, by the use of deep buried cat gut sutures; both patients made easy recoveries."

Mr. Stokes, of Dublin, uses the open method of operation. He freely opens the sac, stitches up the neck, and draws together the canal and pillars of the ring with chromicized cat-gut, carbolized silk, or wire, but does not remove the sac. This he considers risky and unsurgical.

Mr. Alexander, of Liverpool, modifies the open dissection, by tying the neck of the sac, as deeply as possible, and divides below the suture, but does not disturb the sac, or suture the rings. He reports thirty cases performed for the radical cure without a death.

Sir Wm. MacCormac is reported to have adopted this method.

Prof. Buchanan, of Glasgow, in congenital hernia slits up the sac longitudinally on each side of the cord. The anterior part is divided transversely, and sutured into the ring as a plug; the lower part is turned down to complete the tunica vaginalis.

Mr. C. B. Ball,* reports his method of cure of hernia by torsion of the sac. He emphasizes the complete separatiou of the sac from the structures of the cord, a matter sometimes of no small difficulty. "The peritoneum loosened a little about the ring, the empty

*British Med. Jour., Dec. 10, 1887, p. 1272.

sac is firmly held at its neck by forceps, and gradually twisted, generally four or five turns are sufficient, but the torsion should be continued, until it is felt to be quite tight or rupture seems imminent. Thus held, the twisted neck is tied with cat gut as high as possible and the ends cut off short." "Two sutures of strong aseptic silk are now passed through the skin, at a distance of about an inch from the outer margin of the wound, through the outer pillar of the ring, through the twisted sac in front of the cat-gut suture, and then through the inner pillar of the ring and skin upon the inside. As these sutures effectually prevent the sac from untwisting, it may now be cut off in front of them, and a cat-gut drain is brought out, through a separate opening, at the back of the scrotum, and the two sutures closed over lead plates, which lie at right angles to the wound." Superficial sutures are applied if required and a dry dressing is held by a fixed silicate of potash bandage.

Post mortem testing shows the peritoneum to be thrown into spiral folds radiating in all directions from the ring and extending about four inches.

Mr. Ball thinks the twisted sac thus transfixed makes a slight projection, rather than depression, within the abdominal cavity. He reports twenty-two cases of his own, beside a number under his observation done by other surgeons. All recovered. All were performed within four years. Three obliged to wear a truss from a weakening of the ring. Dr. Ball

deprecates the wearing of a truss, since the pressure of the pad tends to produce absorption of the plastic effusion into the canal, upon which the success of the operation so largely depends.

Mr. W. P. Stoker,* of Dublin, advocates the open dissection method, has adopted the plan of Mr. Ball of twisting the neck of the sac, and suturing under aseptic precautions. He argues, as Mr. Ball, that the lymph effusion is the factor sought, that sutures serve but a temporary purpose, and their chief end is to secure an abundant exudation.

Mr. John Poland,† of Guy's Hospital, London, in a paper upon the treatment of the sac in strangulated hernia, reviews the different methods of treatment and commends the ligature of the neck and excision. By it the peritonum is effectively closed from hemorrhage and septic infection and it holds out a great hope of permanent cure, not only in restoring the patient to a more normal condition by removing a more or less open tract along which a portion of intestine might again descend, this tract being in fact composed of morbid and useless tissues, also in producing a radiating puckering of the peritoneum around the hernial orifice and closing the orifice itself by dense cicatricial tissue, and thereby tending to prevent yielding again at this spot.

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* Practitioner, Nov. 1887, p. 355.

† Brit. Med. Jnl., Dec. 3, 1887, p. 1201.

We do away with an indurated thickened mass, which often exists where the sac has been allowed to remain untouched. * * In cases where the opening is large, the pillars of the ring may be brought together by sutures, without adding to the risk of the operation. * * Ligature without excision has no advantage over ligature with excision."

Mr. F. T. Heuston† contributed a most interesting paper to the surgical section of the British Medical Association, upon the radical cure of femoral hernia, and reports an illustrative case in a woman of seventy. The cure was easy and complete, although the sac, besides a loop of intestine contained a gangrenous Fallopian tube and the ovary; both were removed. The sac was tightly twisted and transfixed with chromicized gut, and excised. The canal and fascia were closed by buried sutures. Mr. Heuston remarks, "it is sufficiently rare to find the Fallopian tube and ovary within hernial sacs, to allow another case being recorded; as I find in 1871, there were only thirty-eight cases recorded, namely twenty-seven inguinal, nine femoral, one sciatic, and one obturator. Of these, however, seventeen were congenital, all of which were inguinal and the ovary alone was usually in the acquired herniæ, while only five of the cases contained intestine." Besides the advantage derived from the removal of the sac and closing the periton-

† Brit. Med. Jnl., Dec. 3, 1887.

eum by twisting the neck, Mr. Heuston emphasizes the importance of closure of the tissues "in proper and consecutive order by hidden sutures, the most important being the first applied, namely, uniting the fascia transversalis forming the anterior wall of the femoral canal to the fascia iliaci and anti-psoas layer of the pubic portion of the fascia lata behind and within." He uses chromicized catgut throughout the operation which allows of immediate union and does not require subsequent removal.

In the discussion of Mr. Heuston's paper, Mr. Walsham remarked, "that he thoroughly advocated Mr. Banks' method. He uses "kangaroo tail tendon and believed that when it was securely knotted, it was a most reliable ligature, and preferable to both wire and silk."

Dr. Ward Cousins said "that the surgery of hernia had made recently most rapid advance, especially in the direction of the radical cure in young children. He had operated on more than fifty cases, and thirty of these were cures; the rest had been done too recently to express an opinion. He removes the sac after ligature at the neck and closes the edges with a continuous suture. He advocates silk or wire as more trustworthy than catgut.

No one of the recent contributions upon the cure of hernia has deservedly attracted a larger share of attention than the paper of Mr. Wm. Macewen, of Glasgow, published in the "Annals of Surgery,"

August, 1886. This was supplemented by a further contribution upon the subject to the British Medical Association and published in the Journal.* Mr. Macewen states, "that he was led up to the adoption of his present method by his studies upon the various methods of the treatment of the sac, and, believing that there was generally left a depressed pouch, or funnel-shaped puckering of the peritoneum at the internal ring, which receives the wave of impulse of the liquid movement of the intestine, he sought in the device which characterizes his method, to reinforce the weak spot by a new use of the sac. The steps of the operation are given as follows:

"1. Free and elevate the distal extremity of the sac, preserving along with it any adipose tissue that may be adherent to it; when this is done pull down the sac, and while maintaining tension upon it, introduce the index finger into the inguinal canal, separating the sac from the cord and from the parietes of the canal.

2. Insert the index finger outside the sac till it reaches the internal ring; there separate with its tip the peritoneum for about half an inch round the whole abdominal aspects of the circumference of the ring.

3. A stitch is secured firmly to the distal extremity of the sac. The end of the thread is then passed in a proximal direction several times through

* British Medical Journal, December 10, 1887, p. 1263–71.

the sac, so that when pulled upon, the sac becomes folded upon itself like a curtain. The free end of this stitch, threaded on a hernia needle, is introduced through the canal to the abdominal aspect of the fascia transversalis, and there penetrates the anterior abdominal wall, about an inch above the upper border of the internal ring. The wound in the skin is pulled upwards, so as to allow the point of the needle to project through the abdominal muscles, without penetrating the skin. The thread is relieved from the extremity of the needle, when the latter is withdrawn. The thread is pulled through the abdominal wall, and when traction is made upon it, the sac, wrinkling upon itself, is thrown into a series of folds, its distal extremity being drawn furthest backward and upward. An assistant maintains traction upon the stitch until the introduction of the sutures into the inguinal canal, and when this is completed, the end of the stitch is secured by introducing its free extremity several times through the superficial layers of the external oblique muscles. A pad of peritoneum is thus placed upon the abdominal side of the internal opening, where, owing to the abdominal aspect of the circumference of the internal ring having been refreshed, new adhesions may form.

The sac having been returned into the abdomen and secured to the abdominal circumference of the ring, this aperture is closed in front of it in the following manner: The finger is introduced into the canal,

and lies between the inner and lower borders of the internal ring, in front of and above the cord. It makes out the position of the epigastric artery, so as to avoid it. The threaded hernia needle is then introduced, and, guided by the index finger, is made to penetrate the conjoint tendon in two places; first, from without inwards, near the lower border of the conjoint tendon; secondly, from within outwards, as high up as possible on the inner aspects of the canal. This double penetration of the conjoint tendon is accomplished by a single screw-like turn of the instrument. One single thread is then withdrawn from the point of the needle by the index finger, and when that is accomplished, the needle, along with the other extremity of the thread, is removed. The conjoint tendon is therefore penetrated twice by this thread, and a loop left on its abdominal aspect. Secondly, the other hernia needle, threaded with the portion of the stitch which comes from the lower border of the conjoint tendon, guided by the index finger in the inguinal canal, is introduced from within outwards, through Poupart's ligament, which it penetrates at a point on a level with the lower stitch in the conjoint tendon. The needle is then completely freed from the thread and withdrawn.

Thirdly, the needle is now threaded with that portion of the catgut which protrudes from the upper border of the conjoint tendon, and is introduced from within outwards through the transversalis and internal

oblique muscles, and the aponeurosis of the external oblique at a level corresponding with that of the upper stitch in the conjoint tendon. It is then quite freed from the thread and withdrawn. There are now two free ends of the suture on the outer surface of the external oblique, and these are continuous with the loop on the abdominal aspect of the conjoint tendon. To complete the suture, the two free ends are drawn tightly together and tied in a reef-knot. This unites firmly the internal ring. The same stitch may be repeated lower down the canal if thought desirable. The pillars of the external ring may likewise be brought together. In order to avoid compression of the cord, which might lead to serious embarassment and sloughing, or ultimate atrophy of the testicle, it ought to be examined before tightening the stitch. The cord ought to lie behind and below the sutures, and be freely movable in the canal. It is advisable to introduce all the necessary sutures before tightening any of them. When this is done, they might all be experimentally drawn tight, and maintained so while the operator's finger is introduced into the canal to ascertain the result. If satisfactory, they are then tied, beginning with the one at the internal ring and taking up in order any others which may have been introduced. In the great majority of cases the stitch in the internal ring is all that is required. During the operation the skin is retracted from side to side, to bring the parts into view, and to enable the stitches to

be fixed subcutaneously. When the retraction is relieved, the skin falls into its normal position, the wound being opposite to the external ring. The operation is therefore partly subcutaneous. When the canal has been brought together, a decalcified chicken-bone drainage tube is placed with its one extremity next the external ring, the other projecting just beyond the lower border of the external wound. A few chromic gut sutures are then introduced along the line of the skin incision. The wound is dusted with iodoform, also the interstices of the scrotum, and its junction with the thigh. A sublimated wool pad is applied, held in position by an aseptic bandage."*

Mr. Macewen tabulates eighty-one cases, without a death, and with a firm occlusion obtained before leaving the ward. The material used for sutures, as by far the most serviceable, is considered to be catgut prepared so as to resist the action of the tissues from two to three weeks. The use of decalcified chicken-bone drainage tubes are considered by Mr. Macewen as admirably suited for the operation.

At the meeting of the Congress of Italian Surgeons, March, 1888, Prof. Bassini described a new method of cure in inguinal hernia which he had successfully practiced in one hundred and two cases. The purpose of his method is to restore the obliquity of the canal. He lays open the canal to the internal

*British Medical Jour., Dec. 10, 1867, p. 1264.

ring. The sac is separated, drawn down, ligated, and resected. The closed peritoneum is returned, the spermatic cord is pushed aside, and the posterior margin of Poupart's ligament exposed. The deeper layer is dissected in such a manner that it can be brought in close apposition to the posterior margin of Poupart's ligament.

From the ileo-pubic tubercle, the canal is united, posteriorly, from five to seven centimeters to the entrance of the cord into the abdominal cavity. The cord is then replaced, and the aponeurosis of the external oblique sutured, only opening sufficient for the cord without compression being left. The wound is closed with drainage. The advantages claimed for the operation are that it restores the inguinal canal to its natural condition. The internal opening and the posterior wall are new-formed, the external ring narrowed. This restores the canal to its normal oblique position. The posterior wall, being composed of muscle and aponeurosis, is permanent and will not disappear like the cicatricial plug in Wood's operation. In the author's 102 cases, 95 were reducible and seven strangulated hernias; in 98, the hernia was complete oblique, and in four complete direct. The conclusions are formulated:

"1. The method is absolutely without danger.

2. It effects a radical cure in a short space of time.

3. It obviates the necessity of wearing a truss, as after the other operative procedures."

Andaregg* has published a thoughtful article upon the radical cure of hernia by the removal of the sac and closure of the canal. He gives a long list of cases in detail where the results have been carefully noted. Of a list of 55 patients, where the radical operation was performed, 38 are reported cured, free from any return. In 71 cases there were 11 deaths.

Leisrink† has reported 188 cases of strangulated hernia operated on, and in the list, from all causes, there were 33 deaths. He thinks the return of the hernia is less likely to follow the radical operation when done after strangulation, than when performed in reducible cases. His paper, as well as that of Andaregg, contains much of interest, however, the data are quite too imperfect from which to draw conclusions of exceptional value.

Riesel‡ advocates the division of the anterior wall of the canal as far as the internal ring. He narrows the canal by removing a portion of the anterior wall and unites by transverse sutures from above downwards, so as to close the canal as much as possible, in the belief that, in this way, he reforms and restores the obliquity of the opening. Usually he

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* Die Moderne Radicaloparation der Unterleibs brüche, 1883.

† "Die Radicaloperation der Hernien," Deutsch. Zeitschrift f. Chirurg., 1886.

‡ Otto Riesel, "Deutsche med. Wochenschrift," Berlin, 1887, pp. 449–467.

ties the sac high up and leaves the empty sac below, believing that it gives a farther security and protection from return. The superficial wound he unites over the deeper layer.

Riesel claims by his method of splitting the canal, he can dissect and free the sac to its very base, and, in this way, obliterate any pouching of the peritoneum.

"In Sweden, an 'improved' operation for the radical cure of hernia has, for sometime past, been practiced by Drs. Svensson and Erdmann, Surgeons to the Sabbatsberg Hospital, at Stockholm. A ligature is applied to the neck of the hernia, and the sac is cut off below the ligature, the contents being previously examined by means of an incision into the sac, and returned; or if only omental, excised, together with the sac. In congenital hernia, the upper part of the sac only is removed, and where the large bowel is included in the hernia and adherent to the sac wall, this, after being separated from the surrounding tissues, is returned together with the large intestine, and the rents of Poupart's ligament united by sutures.

The dressing employed is iodoform and boracic acid, the wounds being washed with sublimate solution. Since this has been substituted for carbolic gauze, abscesses, which used to occur frequently, have become rare. Of the 48 cases thus operated on, none of which were selected, 38 were permanently cured; at least, no return of the hernia occurred within six months; and in the cases where a return did take

place, which amounted to 20 per cent., the condition was very much less painful and distressing than it had been previous to the operation.

Sabbatsberg Hospital has now been opened six years and a half, and during that time 300 cases of hernia have been admitted, about 200 of these being operated on with a knife, a milder procedure, consisting of alcoholic injections, being employed in most of the earlier cases. Not a single case proved fatal, though some of the herniæ were very large, some reaching within three or four inches of the knee."*

THE CURE OF HERNIA BY THE OPEN WOUND METHOD IN AMERICA.

It is only very recently that the operation for the cure of hernia has been looked upon favorably by surgeons of the United States.

In 1858 Dr. Gross, of Philadelphia, cut down upon, and brought together the rings with silver wire in two cases followed by cure. In 1878 Dr. D. W. Cheever reported, "I tried cat-gut for a radical cure of hernia, but it was speedily absorbed and failed."

In August, 1886, Dr. John B. Hamilton, Surgeon Gen. U. S. Marine Hospital Service, read before the Chicago Medical Society, a very valuable lecture upon the Radical Cure of Inguinal Hernia.† After a care-

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* (Medical and Surgical Reporter, Philadelphia, 1886, ix., 115.)

† Jour. Amer. Med. Asso , Sept. 4, 1886.

ful review of the open method as performed with antiseptic care, Dr. Hamilton writes:

"As no logical reason can be given for a failure to accept the view that there has been an advance, I perhaps need not say, 'that *I favor in all cases, affording even a reasonable prospect of cure, an operation therefor, and that all cases whatsoever of bubonocele should be operated upon.*'"

Dr. E. H. Bradford,* of Boston, to the Society of Medical Improvement, March 14, 1887, reported a case of radical cure of hernia operated upon recently by Macewen's method.

Dr. T. J. McGillicuddy,† reports a case of radical cure of a strangulated oblique inguinal hernia with ligature, removal of the sac and recovery. He ends his paper with a plea for the removal of the sac and closing with deep firm sutures.

In an interesting paper by Dr. Thomas H. Burchard,‡ of New York, upon the modern treatment of strangulated hernia, the subject of operative measures is carefully reviewed. As is well known, he is an advocate for early operation. He prefers dissection of the sac, suture of the base, and return of the stump; then a careful coaptation of the rings and canal by deep sutures of cat-gut. He reports one case by

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*Boston Med. and Surg. Jour., April 21, 1887, p. 375.

†New York Med. Jour., Dec. 31, 1887, p. 737.

‡New York Med. Jour., Jan. 21, 1888, p. 6-15.

Macewen's method. "This is the only case in which suppuration of any material consequence occurred. Had I ever seen the operation performed, or had I previous experience with it, I might have secured better result. As it is, the cicatrix is very painful, and a hardened mass, at the site of the internal ring, will scarcely tolerate the slightest pressure."

"I have operated in nine cases of strangulated hernia in which I have been enabled to carry out the operation in all its details. Eight recovered, one developed delirium tremens and died the fourth day."

Dr. Robert Weir,* of New York, treats, at some length, the subject of the disposition of the sac after operation. He emphasizes the great advances made in modern surgery, in the treatment of strangulated hernia, contrasts the various methods of treatment of the sac, and thinks, in some cases, the Macewen method advisable. This he has performed eight times. The preference will be between this method and ligation and excision of the sac. He prefers the use of heavy cat-gut. Dr. Weir accepts the radical operation as a marked improvement in the treatment of hernia, whether free or strangulated, although he does not consider the operation perfected.

Dr. Charles McBurney,† of New York, in a contribution upon the radical cure of hernia by the open

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*N. Y. Med. Jour., Jan. 21, 1888, p. 65–8.

†N. Y. Med. Jour., Jan. 21, 1888, p. 58–61.

wound method, reports twenty-seven cases where he has operated in non-strangulated hernias since 1882, by various methods. One patient died of shock a few hours after operation, but he was a hard drinker. All the other cases made easy recoveries. He considers hemorrhage and sepsis the great dangers, both preventable. "The method of closing the sac by ligature is clearly better than the other plan of cutting it off and closing the communication with the peritoneal cavity by suture. It is more rapid, it is more even, and the great danger is absolutely avoided of having the intestines suddenly forced out through the wound by an unexpected effort of coughing or vomiting. Two other methods of shutting off the sac remain to be referred to, that of torsion and of Macewen." * * * "That this method obliterates the sac is evident from the brilliant results obtained by Macewen in a large number of cases, but I question its superiority in ordinary cases over the carefully applied ligature, and in larger hernia it makes no provision at all against the great laxity of peritoneum, which exists in all such cases around the internal orifice of the canal." Dr. McBurney enters into an argument of some length to show why he considers suturing of the canal a useless undertaking, based upon the conditions and relations of the tendinous structures which make up the canal. Because of this, he has abandoned closure and treats by the open method in a manner peculiar to himself. "Six or eight interrupted stitches, on the upper side

of the wound, bind into one thick edge the skin, the external abdominal aponeurosis, including the inner pillar of the ring, and the transversalis and internal oblique muscles and conjoined tendon. As many more stitches, on the lower side of the wound, bind together the skin and Poupart's ligament, including below the outer pillar of the ring." This ensures an open canal, which must slowly fill by granulation. Iodoform gauze is packed into the wound and completes the dressing. Dr. McBurney thinks he obtains double advantage—an antiseptic wound without drainage, and a firm closure of the walls of the canal by strong cicatricial tissue.

Dr. Dudley P. Allen,* of Cleveland, has contributed an interesting article upon the radical cure of hernia in which he advocates the open wound method under strict antisepsis. His method is extirpation of the sac after suturing at the base with catgut and uniting the pillars of the ring with interrupted silk sutures, one end left long; a drainage tube is inserted to just outside the united pillars, and superficial interrupted stitches close the wound. An aseptic state is maintained for a week, when suppuration is allowed and the silk sutures through the ring removed as they become loose. In this way he thinks the plastic repair is more firm and resisting, than in primary union. Reports one case operated on at two years of age. His first operation was in 1885.

* Medical Record, N. Y., Aug. 11, '88, pp. 141-3.

At the meeting of the Suffolk District Medical Society Drs. G. H. Monks and R. Whitman, of Boston, each reported one case of cure of hernia by Macewen's method.* There followed a long discussion by a considerable number of surgeons who had operated for the cure of hernia, and the general opinion expressed was in favor of a radical disposition of the sac and closure of the canal with animal suture.

Dr. H. L. Burrell,† of Boston, reports eight cases of radical operation for the cure of hernia. In the manipulation of the sac, he has found advantage in distending it with a ball of iodoform gauze. He closes the canal with two or three interrupted stitches, silk, or cat gut, and does not use drainage. Closure of the wound is effected by continuous cat-gut suture. Dr. Burrell makes emphasis upon aseptic conditions, and especially in the case of the superimposed dressings; six gauze pads 6x8 in. held in place by careful bandaging, then a piece of macintosh with hole to admit the penis and over this sterilized sheet wadding. A cravat gauze bandage, six inches wide, long enough to form a double spica bandage, holds this in place. Over this is another piece of mackintosh, through which the penis protrudes, held in place by safety pins.

In the same journal, Dr. Hayward W. Cushing, of

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* Boston Med. and Surg. Jnl., Dec. 6, '88.

† Boston Med. and Surg. Jnl., March 22, '88.

Boston, reports a case of femoral hernia in a boy of twelve, where he operated by adapting the method of Prof. Macewen to the conditions found. After freeing the sac, which, in this instance, was attended with difficulty, he replaced and retained it within the ring as advised by Macewen. Dr. Cushing then closed the crural ring by suturing Poupart's ligament with a "quilted suture," to the pubic portion of the fascia lata and the fascia covering the pectineus muscle, the femoral vein being protected by a retractor. The margins of the saphenous opening are then closed by overlapping after Macewen's method in inguinal hernia. The result was excellent.

Dr. L. S. Pilcher, of Brooklyn, has reported to me two cases of strangulated hernia, where he operated with complete cure, in patients each eighty-three years of age.

The first, a male, the hernia inguinal, had existed many years. The sac was double, was dissected, tied high up and cut off. The wound filled with iodoform gauze and allowed to granulate; recovery slow. The second a female; old femoral hernia, the adherent omentum was ligatured and resected, also the sac, the stump of which was pushed within the internal ring and "the tissues of the canal closely sewed over and over with cat-gut, superficial sutures. Healing by first intention throughout whole extent of wound with quite an appreciable plastic exudate in site of canal."

Dr. John H. Mackie, of New Bedford, writes me that he "has operated nearly two hundred times in strangulated hernia with a mortality of only ten or twelve."

"One case I think is a little remarkable. Operated on a man aged eighty-three, right inguinal hernia, strangulated; recovery perfect, but one year later I operated on the same man for left strangulated hernia and he made a good recovery, living for several years." In one case of strangulated femoral hernia, in an elderly woman, the right ovary was found in the hernial sac. Recovery excellent. Dr. Mackie opens the sac, closes the wound by deep cat-gut sutures, and dresses antiseptically.

Dr. A. Van Der Veer,* of Albany, reports two cases of strangulated femoral hernia, operated on under antiseptic precautions, where he dissected the sac, and ligated at the neck with cat-gut and removed. Wound closed by cat-gut suture, horse hair drain, careful dressing with bichloride gauze. Second dressing fourth day and drainage removed, union primary.

Dr. D. G. Wilcox,† of Buffalo, reports a case of irreducible femoral hernia, operated on under aseptic precautions. Epigastric artery cut and tied. Sac dissected, pulled down, transfixed, ligated and cut off. Sutured to ring with catgut, and wound closed. Union primary and recovery rapid. At three months seems cured, wears a truss as a precautionary measure.

*Albany Medical Annals, Oct., 1888.

†North American Journal of Homeopathy, Oct., 1888.

CHAPTER XI.

CONDITIONS RENDERING OPERATIVE MEASURES ADVISABLE.

As a resumè of the chapters upon operative procedures, hernia may be considered from the surgical standpoint under the following conditions:

In Children.—It may be accepted, that in a considerable percentage of children, hernia results from a delayed or imperfect development, where the inguinal canal is abnormally open. In this class, if suitable care can be exercised and pressure be brought continuously upon the canal, especially at the internal ring, cures may often be rapid and permanent. It should be the aim of the surgeon to effect this by a carefully adapted support, supplemented by proper nursing and care. Although enthusiastic from the conviction of safe surgical treatment, it is wise to keep in remembrance the value derived from trusses. The surgeon should consider it his personal duty, not to be relegated to the mechanician, to keep his truss-wearing patients, especially children, under his own observation.

Dr. W. B. DeGarmo,* of New York gives the results of the mechanical treatment of hernia in the analysis of one thousand cases in private practice;

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*New York Med. Jour., March 3, 1888, pp. 236, 237.

over one-fourth of the entire number was dismissed as cured, *i. e.*, all remaining so for at least six months without support; one-third improved, *i. e.*, able to wear a lighter truss than at first and remaining comfortable.

He concludes that, by early mechanical treatment, a large percentage of herniæ occurring under middle age can be cured.

About twelve per cent. of Dr. DeGarmo's cases were under five years of age.

Constipation, tight bandaging of the abdomen, are common causes of hernia in infants. Phymosis is a sufficiently common cause to be borne in mind.

On the other hand, in the earlier years, it is very difficult to fit and retain a truss in position. This is emphasized by the experience of each additional case, and not seldom is instrument after instrument thrown aside in despair. Shall we, as the medical advisor, let hernia in childhood remain uncured? If the farmer has a colt thus affected, and this is not a rare condition in colts, will he allow the animal to grow up disabled? The veterinary surgeon does not hesitate to operate for cure and with very few failures.

If the sufferer is an orphan boy, dependant in the early future upon his developing physical powers, as a bread winner, is it the duty of the profession to allow the poor youth to enter the race for life, often for existence, handicapped at the start? He is unfitted for hard work, cannot enter the public service

where a physical examination is required, and is debarred from many avenues where success and position may be secured.

In Mr. Spanton, the English people have an able advocate for early operative cure. In his address before the International Medical Congress* he writes: "The number of cures effected by trusses is infinitesimal, if we may judge from the report of the London Truss Society, where we find that of a total of 96,886 persons relieved by trusses, only 4,387 are stated to have been cured, *i. e.* 4.53 per cent.

Now, if it be possible to effect the cure of rupture early in life (thereby eliminating at once one-eighth of the whole number of cases) by an operation which shall be both safe and efficient, we are led to enquire, in the words of Mr. Spencer Wells, "Whether it may not be better to operate even on young children, than to expose them for several years to the inconvenience of a truss, with the probability that, after all, a radical cure may not be obtained?

Parents have a certain duty to perform towards their offspring in the matter of physical defects; and in the performance of this duty, it is generally the province of the medical advisor to recommend the course which should be pursued. Hernia is surely a source of greater risk to life than club-foot, or hare-

*On the Cure of Hernia, in Relation to Parents and the Profession. By W. D. Spanton. Trans. International Congress, 1881, vol. ii, pp. 448-51.

lip, or nævus, a crooked limb, or an ankylosed joint. Yet these are conditions for which an operation, and not unfrequently a fatal one, is readily admitted and recommended; whereas it is thought usually sufficient to palliate hernia, by the advice to wear a truss, and allow the dangers and other drawbacks incident to it to continue uncured. It is time this opinion changed, and I feel convinced that those who will not be unwilling to see for themselves the advantages of an operation for the cure of hernia, over the uncertain and unsatisfactory treatment with trusses, will, in a large number of cases, advocate its adoption. Operative measures, in modern days, have not had a fair trial; they have not been carried out on a sufficiently extensive scale to demonstrate their real value."

The knowledge and adoption of antiseptic operative measures which have become general since the date of Mr. Spanton's writing, gives yet more force to his earnest plea in behalf of this large class of helpless sufferers.

When it shall have been determined wise to operate in childhood, there is little to emphasize about the operation which does not pertain to adult life. All the tissues are more delicate, they are vascular, but, on this account, will admit of the more rapid repair. The sac is usually very thin, and it may be more troublesome to manipulate than in adults. On the other hand, its surgical treatment is of less importance. If easy to be separated, let it be treated by

dissection, ligation, or suture at neck, and removed as in adults. If congenital rather than acquired, it is best to suture across, in order to complete the tunica vaginalis testis, and close it down upon the cord, then continue the buried animal suturing so as to close and, as far as possible, increase the obliquity of the canal. Care must be exercised not to press too closely upon the cord, but when the cord is only pressed upon, in an even continuous seam, it is surprising to note, if the wound is aseptic, how little the scrotum and its contents suffer in their nutrition. Sepsis and its result is the usual cause of scrotal edema, etc., which has generally been ascribed to pressure upon the vessels of the cord. If, after the operation, the aseptic state is maintained, edema in any degree, or even tenderness of the scrotum, is the decided exception. When the canal is reformed, and the rings properly closed, continue the suturing of the tissues, in evenly approximated layers, until the lips of the wound are in close juxtaposition including the skin, and all by the use of a fine buried tendon suture. In this way the tissues are held at complete rest, without hemorrhage or separation, and nothing is left to drain, therefore the drainage tube or its equivalent is avoided. This is of the first importance, especially in children, since it allows the complete closure of a wound, which the competent surgeon can make aseptic, and its hermetic sealing from subsequent infection. This is assured in a dried wound, dusted with iodoform and

covered with iodoform collodion, into which a few fibres of cotton have been incorporated. To the surgeon, who has labored for years to secure an aseptic dressing with pads, gauze, bandages, macintosh, antiseptic cotton, or wool, until he made a little mummy of his patient, only to find, after all his care, that the doubly restless little prisoner had generally succeeded in both urinary and fecal defilement of all his protection, such germ proof dressing will be welcomed as the near approach to perfection.

Dr. Gerster,* of New York, advocates the operation, in children, by closing the neck of the sac and packing the wound with iodoform gauze, treating it as an open wound to heal by granulation. This he prefers, since, in children, there is so much difficulty in keeping the wound from being soiled by the excretions, and deep-seated septic inflammations result.

The quiet of the bed, with light diet, loose dejections, the interest and amusements of playthings, and the little patient will hardly seem sick, and I think the statistics of to-day are sufficient to warrant, in competent hands, a mortality not to exceed one per cent., with not less than seventy-five per cent. of permanent cures. I hazard little in predicting that greater familiarity with the operation, with careful attention to detail, will make the result as certain as in almost any operation in surgery.

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*On Strangulated Hernia in Children, by A. G. Gerster, N. Y. Med. Jour., Jan. 21, 1888, p. 71.

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The age at which operation may be advised will depend upon condition. There is nothing in age, *per se*, to debar operation.

I operated upon one little fellow only sixteen months old, and he continued nursing during the few days he was under care, and scarcely once cried, as if in pain. When dismissed from observation, three months after, the cure appeared complete.

OPERATIVE PROCEDURES IN ADULTS.

Inguinal Hernia in Woman.—The radical cure should be seriously considered in all cases, occurring in the female, where difficulty of retention or serious inconvenience results. Age, occupation, social position, etc., are, as ever in surgery, factors in the problem.

Operation, in woman, is to be the more favorably considered, since the absence of the cord allows a complete and firm closure of the canal.

Inguinal Hernia in the Male.—As I pointed out, when discussing the etiology of hernia, the large proportion of the cases are of this variety, and operative measures, to effect a radical cure of hernia, must be especially adapted to be applicable to this class. I have traced, in detail, with special care, the history of operations, attempted for this end, through the literature of surgery, since the problem for, at least a century has been clearly defined in its varying factorage, and the best minds of the generations have given un-

wearied, devoted study to the subject. The necessary patency of the canal is the condition, more than any other, which has been the reason of failure. To constrict and not occlude, to allow a free escape of the cord with unimpaired circulation and function, and retain all beside, is a problem, the happy solution of which, by a delicate adjustment of means to ends, is scarcely exceeded in all surgery.

For a considerable period, the resultant cure was effected by the sacrifice of a testicle and cord, and the end attained by this measure was so satisfactory that such numbers sought relief at this cost, it was forbidden by legislative enactment. Open dissections fell into disuse, only to be revived within the last few years. Subcutaneous closure with the wire suture, in a manner, led up to, and made the way for again resorting to the open wound method, and closure of the canal and rings by buried sutures. Success by this method, however, could not be assured until antiseptic surgery taught the measures necessary to secure the closing and retention of the wound free from infection. In the review of the recent literature, which I have given at length in a former chapter, it is shown by abundant demonstration, that the operation for the permanent cure of hernia may be entered upon with the assurance of success, almost, if not quite equal to that of any well established surgical procedure.

I have quoted reports of operators who have given 779 cases with only five deaths, and these

are explained as having been produced by causes other than from the operation. The remote results are not sufficiently defined to tabulate, for the reason that most operators agree that it is necessary that a case should remain for a considerable length of time without evidence of return, before being classified as permanently, or radically cured.

The general consensus of surgical opinion, at present, emphasizes the factorage of operative measures in the treatment of inguinal hernia as:

1. The free dissection, or open wound method, under rigid antiseptic precautions.

2. The treatment of the sac.

All agree to the importance of the peritoneal pouch as a factor. At present it is treated in a variety of ways.

It may be returned unopened, and the canal closed.

When this is done, especially when the hernia is small and the internal ring remains firm, it is fair to assume that it slowly contracts and becomes greatly diminished in size, very probable is often consolidated into a puckered mass, which remains, for a considerable period, as an indurated swelling. This may serve as a wedge to reopen the pillars of the ring, rather than as a buttress of defense. When a depression over the internal ring remains, we not only have a peritoneal pouch, but a weakened, slightly open ring. In this condition, the wave-like motions

of the fluid intestinal contents will impinge into the recess, very likely to re-form a hernia, which, upon severe strain, comes to the knowledge of the sufferer as a rupture occurring suddenly.

If the sac is of considerable size, the general opinion, although not accepted by all, is that it should first be opened, to ascertain its contents, if any, and its relation to the canal and rings. The objection urged against its opening is that it is continuous into the abdominal cavity, and a peritonitis might be engendered. This is not, however, considered valid by antiseptic operators.

It is also generally advised to dissect the sac after opening, quite freely, to within the internal ring; and this for the purpose of securely closing its abdominal orifice. The profession are divided as to the best means of effecting this closure. The larger majority advocate the ligature or suture, some adopt Mr. Ball's method of twisting the sac and a retaining suture, as more likely to obliterate the peritoneal pouch; others, more recently, have followed Mr. Macewen, in the adoption of his ingenious method of puckering into folds the sac, and drawing it quite within the ring to become attached and serve as a buttress to deflect the intestinal impulse.

In the careful review upon the formation of the sac, it was shown that the normal peritoneum, within a considerable limit, is elastic and there can be little doubt but that, when the sac is freed quite within the

ring, it can be safely drawn down and ligatured or sutured, so that no depression results. I have verified this in one case at post-mortem examination, where I sutured the neck. In one case also, three months after operation, I found a slight peritoneal depression, where I returned the sac unopened. When well drawn down and the ligature tightly applied, the puckering in folds occurs quite as in Mr. Ball's method of twisting.

The advantages of Mr. Macewen's buttress are probably theoretic, rather than real. The use of the sac, as a plug to close the ring, sutured and retained, has very generally been abandoned as unsatisfactory. Nearly all operators, at present, think the sac an abnormal, deleterious portion of useless material to be removed. Utilized as proposed by Mr. Macwen, if it forms a buttress, as supposed, to receive the intestinal impulse, may it not be equally inferred that it would be likely to act as a wedge to press unevenly against the newly formed tissues of the restored canal and thereby cause harm, rather than serve as a deflector of pressure? Although the peritoneum forms a pouch or pocket surrounding the hernial contents, nature did not intend it to serve as a part of the supporting abdominal wall, but by an even, elastic, smooth surface, lining the firm muscular and tendinous structures, to allow the abdominal contents to glide easily and evenly in every direction. It is very probable that, when the peritoneum is thus disposed of, its vas-

cularity and nutrition reduced to the minimum, absorption slowly ensues and, in the end, leaves a smooth even surface. If Mr. Macewen's disposition of the sac is an improvement by serving, as he thinks, as a reinforcement of the parts, it might, by some, be inferred that this construction should have entered into the primal organization of mankind.

It has seemed to me, that the wise effort of the surgeon should be to restore, as far as possible, the primal conditions. The peritoneum is normally slightly introflected at the ring, but loosely attached, and may be moved quite freely by slight traction in all directions, independent of other structures of the abdominal wall. When it is considered that the internal ring is ovate, rather than circular, it would seem best, in closing the sac, at its mouth, to do this in the direction of its longer diameter, as less likely to leave folds. This gives as the resultant, a smooth, rather than puckered peritoneum, in the largest degree vitalized and resiliant, as freely movable as possible upon its exterior loosely attached fascia. In the attempt at this, no method would appear superior to the evenly closed mouth of the sac by a continuous seam.

However, there can be no doubt that good results follow any method which closes the mouth of the sac and causes its obliteration.

CHAPTER XII.

METHOD OF OPERATION.

More important, in my judgment, than the disposition of the sac, is the subsequent treatment of the wound. Here again authors are at variance.

A small class think the removal of the sac all sufficient to effect a cure. However, it needs little argument to show, if cure results, it is not from the closure of the peritoneum alone, but the rather, to the firm union ensuing in the wound. The patient, in the horizontal position, without strain to the abdominal wall, the wound, even if open and septic, naturally cicatrizes slowly, but firmly, and there can be no doubt many excellent results follow. Several operators have deliberately chosen this method, the wound aseptic, by packing with iodoform dressing, as both safe and advantageous. It is not very unlike an aseptic wound kept open to its base by a large drainage tube. To this method, however, there are several objections. First, it does not allow of a reformation of the obliquity of the canal. Second, a granulating wound, even aseptic, heals slowly and the resultant cicatrix, if firm, is inelastic and often painful for a long time.

In a former chapter, in the study of the anatomy of the inguinal canal, it was pointed out that nature designedly constructed it to course through the abdo-

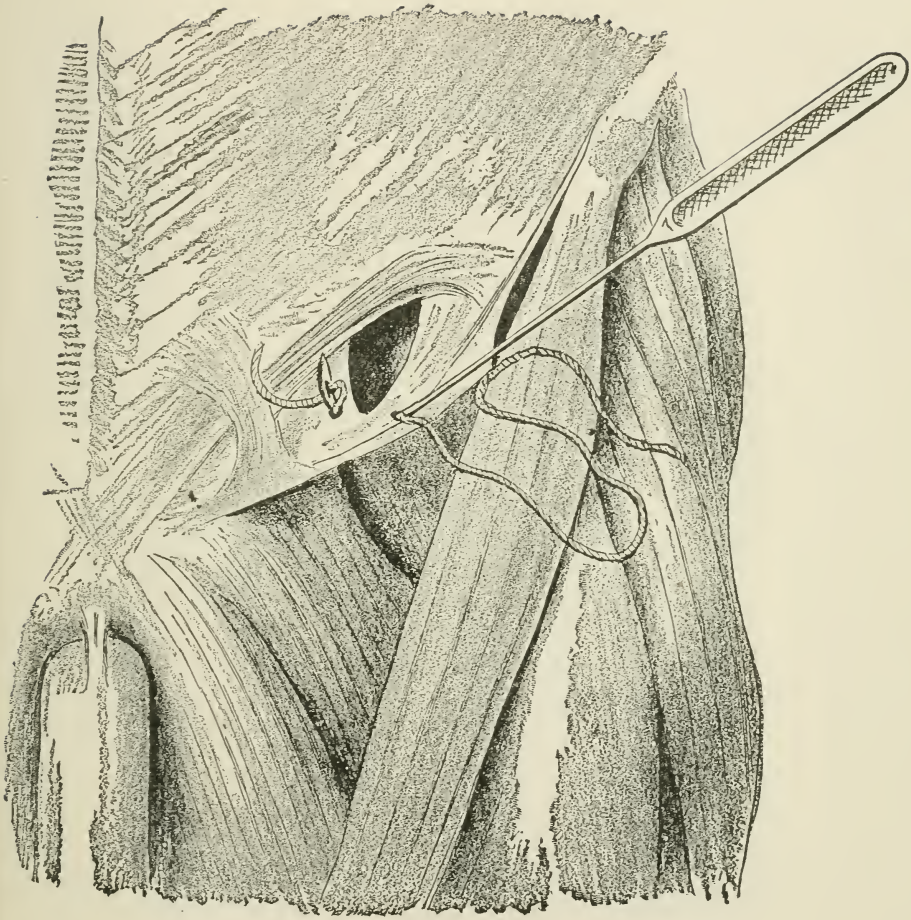

FIG. 15.

Inguinal Hernia, showing the first stitch taken for the closure of the internal ring from below upwards in order to reform the inguinal canal. See also pages 84 and 85.

minal wall, so obliquely that ordinary pressure from within outwards served to bring its walls into lateral apposition.

The most important of all the measures to be sought in the cure of hernia, in my judgment, is the restoration of the obliquity of the canal. This can only be effected by the open dissection method, since the restoration must commence at the internal ring. I cannot help thinking that to this, rather than the peculiar disposition of the sac, is owing the excellent results of Mr. Macewen's operation. His method of restoration of the canal is excellent. Where the hernia is old and large, the parts are deformed and the criticism of Mr. Banks is justly taken, that the aponeurosis of the external oblique, stretched and attenuated, leaves little material for the suturing of the external ring. In these instances, the hernia approaches to the form, called direct, *i. e.*, the opening appears to be almost at right angles to the abdominal wall. It is, in this class of cases, that the cure of hernia is especially difficult. The method advocated and practiced with such success by Prof. Bassini and myself, seems the one to be adopted. The cord is pushed gently aside, and the internal ring is narrowed from below and within, upwards and outwards, leaving only sufficient space for the cord at its upper and outer border. This is best effected by the double, tendon suture, and is not nearly as difficult as would appear. The base or under portion of the canal thus

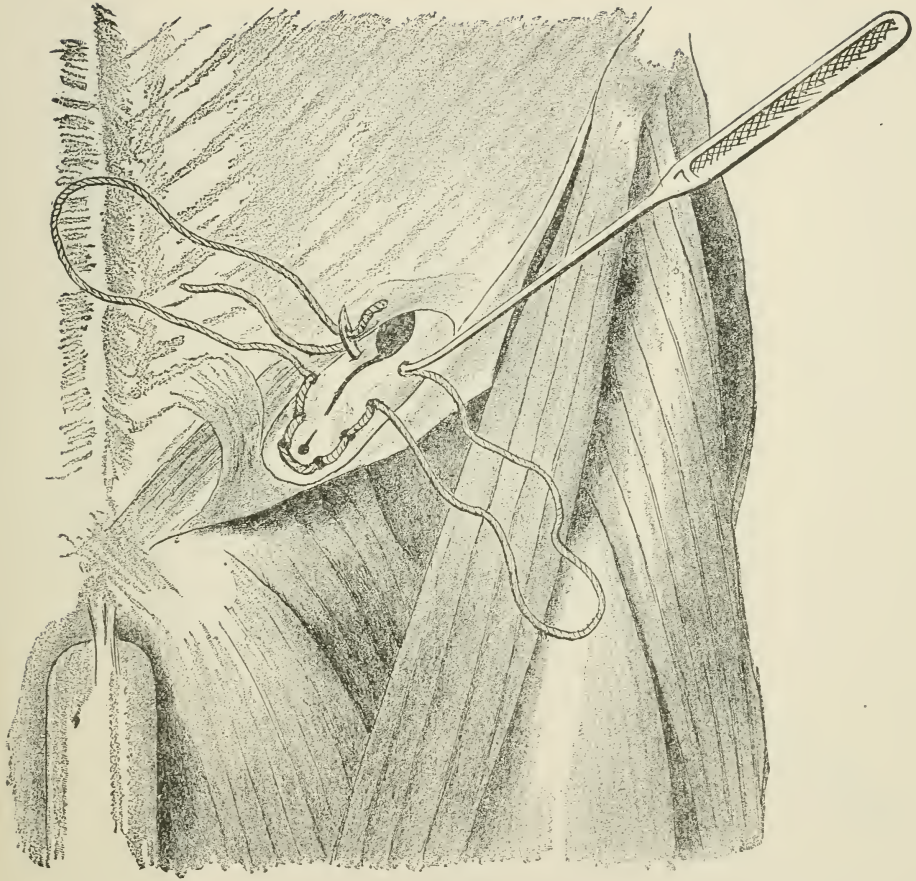

FIG. 16.

Inguinal Hernia, showing the manner of closure of the internal ring with the double continuous tendon suture. The needle rethreaded for withdrawal.

reformed, the cord is replaced, and the outer and superficial layers are closed from above downwards by the same double suture, in even continuous seam, as far inwards upon the pillars of the ring as safety to the cord will permit.

The cord may thus be inclosed within a canal, restored to its normal size, length, and obliquity. The superficial tissues, as also the skin, are closely and evenly approximated by the buried animal suture as described in the treatment of the wound in strangulated hernia. This is the more important since we are enabled to do away with the drainage tube; never needed in any wound, when healthy aseptic surfaces can be approximated, but invaluable in septic wounds.

The avoidance of the drainage tube renders available the closure of the wound by a germ-proof dressing of iodoform collodion, the advantages of which have previously been emphasized.

If the above methods of operation for the radical cure of inguinal hernia, as now appear, are the best which surgery can at present furnish, and if they are as safe in competent hands as the collated experience seems to show, in what cases or class of cases should the operation be advised?

1. All agree, every case operated on for strangulation, should be given the advantages to be derived from the attempt at cure. This we have seen, so far as the wound itself is concerned, independent of the condition of the hernial contents, affords conditions

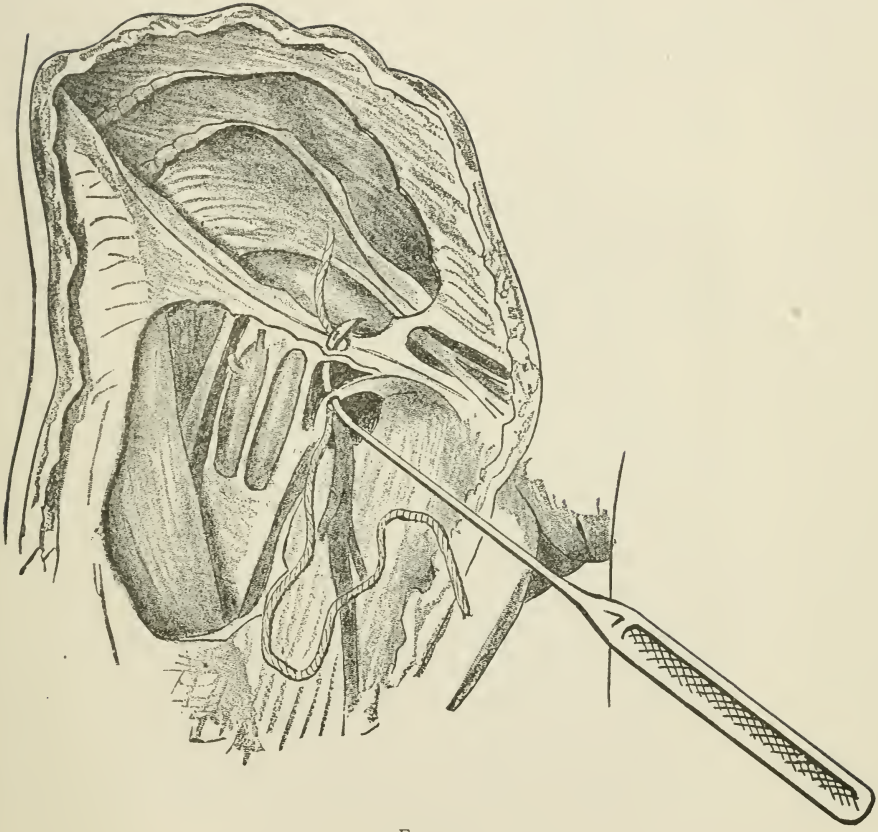

FIG. 17.

Femoral Hernia. The first stitch taken parallel to vein for closing the crural ring. See also page 100.

not much less favorable for cure, than when undertaken primarily for this object.

2. It should be advised in the large majority of cases of irreducible herniæ, and where much difficulty is experienced in retaining the parts in situ by a truss.

3. There are often other reasons which would influence a favorable consideration for operation; such as occupation, change of residence to surroundings where surgical aid could not be furnished in case of need, as for example, a residence in the Colonies, India, South America, the Northwest.

FEMORAL HERNIA.

What has been said in relation to the operation for the cure of inguinal hernia, may be emphasized when we consider the operative measures for femoral hernia. The relation of the sac and its contents to the surrounding parts, already fully discussed in a previous chapter, teaches the greatly increased danger of this variety.

When the sac is sufficiently large to allow the occasional invagination of a loop of intestine, the individual runs a risk of life not to be underestimated. The retention by a truss is more difficult, and when strangulation occurs, the danger is much greater than in strangulation of the inguinal variety, owing to the tense, firm, sharp border of the ring.

Until recently, the radical cure of femoral hernia was scarcely considered, except following operations

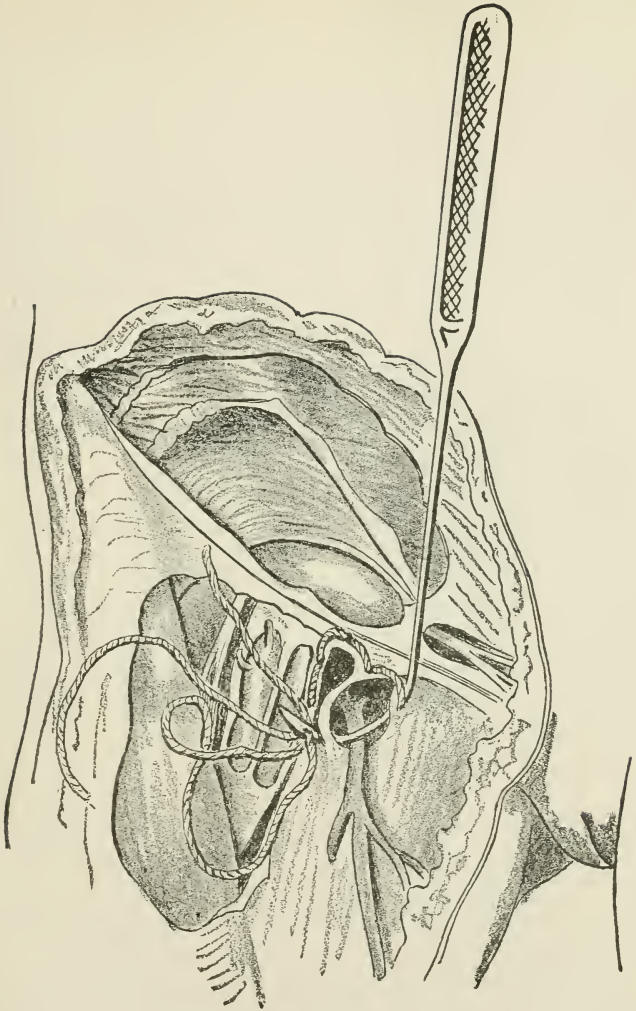

FIG. 18.

Femoral Hernia, showing a third stitch taken for the closing of the canal by the use of the double continuous tendon suture. The stitches are represented as loosly drawn in order to the better show the method of suturing. The needle is passed through the firm pubic fascia and the outer border of the saphenous opening and when drawn closely will fold the latter inwards.

for strangulation. Mr. Macewen's method for the closure of the ring and narrowing of the canal, as illustrated in the case of Dr. H. W. Cushing, of Boston, is excellent. The disposition of the sac, however, after his method, is open to more serious objection than in inguinal hernia, making, almost of necessity, a hard, painful swelling, slow to disappear. The operation, as described in a former chapter for strangulated femoral hernia, need not be repeated here. To one familiar with the anatomy, the dissection is not difficult and the introduction of the sutures quite easy. The incision often may not be a long one. The success is dependent upon doing away with the sac, and the narrowing of the ring and canal to the minimum, consistent with safety to the vessels. When this is done antiseptically, it is surprising to note how closely the vessels may be closed down upon, without the slightest disturbance of the circulation.

UMBILICAL HERNIA.

Little is required to be added to the discussion already entered into in a former chapter upon strangulated umbilical hernia.

Laparotomy, in the hands of many surgeons, is now considered of itself of so slight danger, as to be counted a minor operation. This is certainly true in exploratory incisions, under careful antiseptic conditions.

The removal of an umbilical hernial sac is scarcely

more than an exploratory operation. In the reducible variety, the abdominal contents are not disturbed, scarcely seen. The sac is resected and the parietal walls closed. When we remember that the intra-ab-

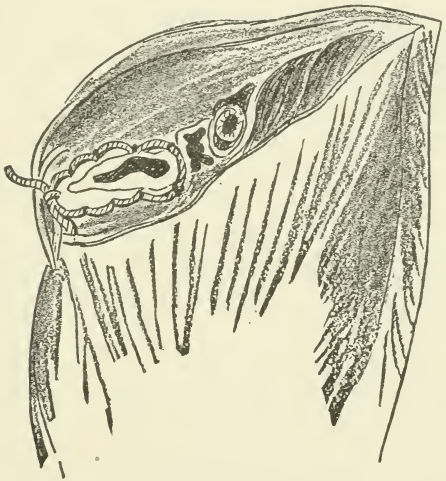

Fig. 19.

Femoral Hernia, showeng the crural ring closed by means of the double continuous animal suture. Stitches loose to show method of suturing.

dominal tension is generally much greater than normal, it is usually wise to pass so-called retaining sutures, to entirely include the suturing of the wound, thereby holding it, as in a splint, at rest until union is

effected. It is generally advisable to do this with wire passed quite outside the other sutures, and external to the peritoneum. These are placed in position after the peritoneum has first been closed by a continuous animal suture, and are not twisted until after the external wound has been hermetically sealed. Drainage is unnecessary when the wound has been aseptically closed in layers of buried sutures, as in all the other varieties. It is, however, for obvious reasons, less dangerous in its use than about the groin.

Ventral hernia of any variety may be classed with the umbilical in the general direction for operative measures.

In conclusion, the details of the open wound operative method, advocated in the treatment of the varieties of hernia consist:

1. *Preparation.* — Disinfect carefully operator, assistants, sponges, and instruments.

Maintain strict asepsis during the operation with the same care as in laparotomy.

Place the patient upon a table in a good light.

Carefully shave the parts.

Disinfect by scrubbing with brush and soap in 1-1000 mercuric bichloride solution.

Cover with light rubber cloth the abdomen and thighs except about the hernial region.

Place over these towels wrung from the 1-1000 mercuric solution.

Conduct the stages of the operation under irriga-

tion with the mercuric solution 1-2000 until the last stitch is taken.

Often not a single sponge is required and each step of the operation can be directed by seeing exactly the state of the parts.

2. *The Sac.*—The sac should generally be opened and dissected free, quite within the ring; sutured across at its very base, and removed.

3. *The Reconstruction by Buried Animal Sutures.*—The reformed peritoneum is allowed to retract within the abdominal wall.

The pillars of the ring are slightly refreshed.

The posterior wall of the canal is reformed by narrowing the internal ring from below upwards and outwards. This is best, and perhaps easiest done by buried tendon sutures, applied in an even, continuous double stitch.

The pillars of the ring are closed downwards, in the same manner, as far as safety to the cord will permit.

4. *The Treatment of the Wound.*—The superficial tissues are brought into juxtaposition by a line of continuous buried animal sutures, and the skin coapted by a running blind stitch taken from side to side through the deep layer of the skin. In this way the divided tissues are rejoined and drainage is not required. The line of the incision is dried, dusted with iodoform, and sealed with iodoform collodion. A soft wool pad is usually applied for protection, but is required for no other purpose.

The advisability of when to operate, in any given variety of hernia, is always to be seriously considered as an independent problem, the factorage of which must consist of many individual details.

There can be little doubt the surgery of the future will include a large percentage of the sufferers from hernia which the conservative surgeon of to-day relegates to the truss-bearing army of invalids. My own feeling, in the conclusion of my labors, cannot be better expressed than in the noble words of Sir Spencer Wells, who wrote in 1858: "The relief of a strangulated hernia is justly regarded as one of the noblest triumphs of operative surgery. The surgeon saves the life of the patient without removing or deforming any part of his body. But the surgeon who cures hernia radically, with certainty and safety, is a greater public benefactor, as he not only relieves large numbers of his fellow-creatures from suffering, but he averts the danger of a strangulation to which they are continually exposed, in a greater or less degree, through every period of life."

INDEX.

A.

PAGES.

Abdominal Hernia 1, 97, 115, 125
Supports 54, 138, 214
Abernethy, John 134
Accidental Hernia 60, 117
Acrel 134
Acquired Congenital Hernia 24, 185
Adhesions of Sac 27
Adjustment of Trusses 56, 123
Aeginata Paulus 128
Age as Affecting Hernia 8, 9, 175, 214
Agnew, D. H 158
Albucasis 128
Alexander, W 193
Allen, Dudley P 210
Allis's Herniotome 82
Anatomy of Hernia 32
Femoral Hernia 89
Inguinal Hernia 33, 37, 50
Strangulated Hernia 64
Umbilical Hernia 113
Andaregg 204
Animal Ligatures in Surgery 168, 170, 175
Annandale, Prof. T 176
Antiseptic Measures in Cure of Hernia 83, 165, 222, 236
Arnaud, M 115
Arteries, Danger of Wounding 81
Epigastric 45, 81, 94
Obturator 94, 113
Umbilical 120

PAGES.

Author's Operation for Radical Cure of Hernia... 79, 85, 105
124, 167, 226, 228
of Femoral..... 103, 232
of Inguinal.. 72, 227, 229
of Obturator..... 117
of Strangulated...85, 230
of Umbilical.... 124, 234
Avicenna..... 128

B.

Ball C. B., Torsion of Sac..... 193
Banks, W., Mitchell..... 182
Barker, Arthur..... 186
Bassini, Prof..... 202
Baxter, J. H., Tables..... 5, 6, 7, 9
Belmas, M..... 138
Birket, John..... 60, 83, 113
Boinet, A..... 145
Bonnet, M. A..... 138
Bradford, E. H..... 207
Bubonocele..... 26, 69, 207
Buchanan. Prof. George..... 193
Burchard, T. H..... 207
Burrell, H. L..... 211

C.

Camper, Peter.....32, 35
Canal, Formation of.....20, 46, 48
Femoral.....89, 97
Inguinal.....20, 41, 47
of Nuck..... 21
Reformation of.....76, 108, 228, 237
Carbolized Catgut Sutures..... ....168, 176, 185, 211
Carnochan, Prof..... 142

PAGES.

Castration as a Means of Cure of Hernia..... 131
Causes of Hernia..... 12, 23, 97, 113
Cauterization as a Means of Cure..... 128
Championnière, Lucas..... 182
Chase, Heber..... 58
Cheever, D. W..... 160
Church, M. D..... 117
Clarke, A. P..... 166
Classification of Hernia..... 1, 2, 8
Cloquet, J..... 17, 28, 34, 94, 116
Congenital Hernia..... 23, 49, 88, 218
Hydrocele..... 22
Conjoined Tendon..... 38, 150
Cooper, Astley, Sir..... 14, 24, 32, 57, 60, 77, 97, 115
B..... 117
Cord, Spermatic..... 21, 43, 218
Cousen's Ward..... 197
Cremaster Muscle..... 21, 43
Cribriform Fascia..... 89, 98
Croft, J. M..... 8
Cuénod, Victor..... 178
Curling, T. B..... 20
Cushing, H. W..... 211
Czerney, V., Prof..... 177

D.

Dangers of Wounding Vessels..... 81, 94
Darling W. Boundaries of Canal..... 48
Davenport, J. H..... 146
De Garmo, W. B..... 214
Development of Hernia..... 12, 14, 23, 24, 49, 65, 97, 113, 120
Diagnosis, Importance of Early..... 72, 103, 111, 124, 216, 223
Diaphragmatic Hernia..... 2, 127
Direct Inguinal Hernia..... 33, 227

PAGES.

Dowell, G. 158
Duveney 116

E.

Elongation of Mesentery as Cause of Hernia 12
Encysted Hernia 24
Enterocele 2
Entero Epiplocele 52
Epigastric Artery 45, 81, 94
Erdmann 205
Eve Paul 170
Excision of Sac 85, 107, 125, 173, 218, 237

F.

Fabricius ab Aqua Pendente 128
Falciform Process 91, 107
Fascia Camper's 35
Cribriform 89
Deep or Fascia lata 89, 92
Propria 97
Transversalis 39, 48
Femoral Canal 93
Hernia 89, 92, 95, 100, 232
Ring 93
Ligament of Hey 91
Formula for Injection—Heaton 140
—Warren 147
Franks Kendall 184
Frequency of Hernia According to Age 8
Locality 5
Nationality 7
Sex 4
Funicular Process 23

PAGES.

G.

Garengeot Jacques..... 108
Gay, G. W..... 160
Gerdy, P. M..... 137
Gimbernat..... 93
Gimbernat's Ligament..... .....36, 91, 93, 105
Greene, N..... 58
Gross, S. D..... 206
Gubernaculum Testis..... 20
Guy's Hospital Reports.....24, 51

H.

Haller, A..... 23
Holthouse Carsten..... 140
Hamilton, John B..... 206
Hardie, James 191
Heaton, G. H..... 145
Heath, Christopher..... 187
Hernia Defined..... 1
Classified.....2, 9
Causation of.....9, 12, 23, 97, 113
Frequency of.....4, 5, 7, 9
In Children.....22, 121, 214
In Adults.....113 175, 220
Accidental..... .....60, 117
Acquired Congenital..... .....24, 185
Congenital..... . .23, 49, 88, 218
Diaphragmatic.....2, 127
Encysted..... 24
Femoral.....1, 89, 92, 94, 96, 232
Incarcerated.....14, 180, 181
Inguinal..... .....1, 20, 33, 48, 51, 220, 227
Irreducible.....14, 59
Ischiatic.....2, 119

PAGES.

Hernia, Oblique Inguinal....41, 48
Perineal.... 2
Reducible Inguinal....14, 52
Scrotal....51. 60
Strangulated....64, 67, 72, 79, 85, 234
Umbilical....120. 234
Ventral....2, 127, 236
Herniotomy.... 79
Hesselbach, F. K.... 98
Heuston, F. T.... 196
Hey's Ligament.... 91
Hilton, J.... 116
History of Operations....128, 177, 206
Hunter, John.... 23
Hydrocele.... 19

I.

Incarcerated Hernia....14, 180, 181
Infantile Hernia....22, 121
Inguinal Canal....20, 41, 47
Hernia....1, 20, 33, 48, 51, 220, 227
Injection as a Cure of Hernia....144, 116
Instruments....79 81, 86, 146
Instrumental Supports.... 54
Internal Abdominal Ring.... 39
Irreducible Hernia....59, 103
Ischiatic....2, 119

J.

Jameson, H. G.... 137
Jobert, I. A.... 145

K.

Kangaroo Tendon....172, 197
Keetley, C. B.... 187

PAGES.

Kingdon's Table..... 9
Knife, Hernia..... 79, 82

L.

Langenbeck, C. J. M..... 132
Lawrence, W.....98, 123, 132
Leisrink H. W..... 204
Ligament, Gimbernat's..... ..36, 95
Poupart's.....37, 45, 46, 89, 91, 105
Triangular..... 39
Ligature, Animal.....165, 218, 229, 231
Linea Alba..... 36
Lister, Joseph, Sir..... 165
Lucas, C..... 192

M.

Mackie, J. H..... 213
Macewen, Wm..... 197
Malgaigne, M.....4, 8
McBurney, Charles..... 208
MacCormac, W..... 193
McGillicuddy, T. J..... 207
Mesentery..... 12
Muscle, Cremaster.....21, 43
External Oblique..... 35, 37
Internal Oblique 38
Transversalis ... .38, 39
Monks, G. H..... 211

N.

Nationality as Affecting Hernia..... 9
Neck of Sac..... 26, 64, 75, 105, 218
Needle, Hernia, Dowell's, G..... 158
" " Marcy's, H. O..... 86

PAGES.

Needle, Hernia, Wood's, J..... 149
" " Wood's, T..... 147

O.

Oblique Inguinal Hernia..... 48
Obturator Artery.....94, 113
" Hernia..... 113
Obré..... 117
Occupation as Affecting Hernia 9, 220
Omentum, Removal of..... 75, 81, 97, 117, 125
Operation for Cure of Hernia 78, 85, 103, 124, 175, 222
Advantages of the Open Method, 167, 174, 222, 230
Conditions Rendering Advisable.....72, 103, 214
In Children. 214
Adults..... 220
Details of Open Method.....79, 105, 236
Operators, See List of.....
Operative Measures.... ..... 72, 79, 85, 103, 214, 236

OPERATORS—THE OPEN WOUND METHOD: EUROPE.

Alexander, William..... 193
Annandale, Thomas, Prof..... 176
Andaregg 198, 204
Banks, W. Mitchell..... 182
Barker, Arthur..... 186
Bassini, Prof..... 202
Buchanan, George..... 193
Championnière, L..... 182
Cousens, Ward..... 197
Czerney, V. Prof..... 177
Franks Kendal..... 184
Hardie, James..... 184
Heath, Christopher..... 187
Heuston, F. T..... 196

PAGES.

Langenbeck, C. J. M..... 132
Leisrink, H. W..... 204
Lucas, Clement..... 192
Mac Cormac, Wm..... 193
Macewen, Wm..... 198
Poland, John..... 195
Puzey, Chauncey..... 187
Rabagliati, A..... 188
Riesel, Otto..... 205
Robinson, A. W..... 186
Shede, Max..... 177
Schumucker..... 132
Socin, Prof..... 178
Spanton, W. D.....210, 216
Steele, Charles..... 176
Stoker, W. P..... 195
Stokes, Wm..... 193
Svenson..... 205
Treves, F..... 188
Tilanus, J. W. R., Prof..... 182
Walsham, W. J..... 191
Wells, Spencer..... 216, 238
Wright, G. A..... 188
Wood, John.....84, 109, 148

IN AMERICA.

Allen, Dudley P..... 210
Bradford, E H..... 207
Burchard, T. H..... 207
Burrell, H. L..... 211
Cushing, H. W..... 211
Dowell, G..... 158
Gay, G. W..... 160
Hamilton, John B..... 206

PAGES.

Mackie, J. H. ... 213
McBurney, Charles ... 208
McGillicuddy, T. J. ... 207
Monks, G. H. ... 211
Pilcher, L. S ... 212
Storer, H. R. ... 126
Van Der Veer, A. ... 213
Weir, Robert ... 208
Whitman, R. ... 211
Wilcox, D. G. ... 213
Wilson, A. H. ... 70

P.

Paletta ... 22
Pancoast, Joseph ... 144
Peritoneal Pouch ... 21, 49, 97, 108, 222, 224
Obliteration of ... 100, 108
Sac ... 19, 50, 77, 86, 107
Peritoneum ... 15, 25, 49, 224
Changes in ... 16, 25, 30
Elongation of ... 18, 28
Pilcher, L. S ... 206, 212
Poland, John ... 195
Poupart's Ligament ... 37, 45, 48, 89, 91, 105
Pott, Percival ... 129
Processus Vaginalis ... 21
Punctum Aureum ... 129
Puzey, Chauncy ... 187

Q.

Quercus Alba ... 145

R.

Rabagliati, A ... 188

PAGES.

Radical Cure of Inguinal Hernia.....79, 220, 228
Femoral Hernia.....103, 232
Obturator Hernia..... 115
Umbilical 124, 234
Resumé..... 230
Riesel, Otto..... 204
Ring Closure by Use of Catgut or Tendon Suture..86, 108, 174
218, 228, 237
Wire.....109, 149
External Abdominal.....36, 80, 104
Femoral or Crural..... .....93, 97, 108
Internal Abdominal 39, 81, 96
Pillars of 35, 104, 151, 201, 222
Royal Suture..... 129
Robinson, A. W..... 186

S.

Sac, Adhesions of 27, 30, 59
Changes in.....25, 27, 30, 68
Contents of 66, 68, 81, 98, 113, 121
Disposition of.... .....76, 84, 105, 125, 177, 189, 237
Formation of.....14, 19, 23, 77, 105
Saphenous Opening..... 89, 92, 108
Scarpa, H.....23, 115
Schede, Max..... 177
Schreger, B. G..... 22
Scrotal Hernia.....50, 62
Seiler, B. G..... 22
Septum Crurale.....94, 97
Seton, Use, as a Cure..... 139
Sex, as affecting Hernia.....8, 220
Schumucker..... 132
Sigmoid Flexure..... 13
Simmons, P. G..... 172

PAGES.
Socin, Prof. 178, 181
Spanton, W. D. 216
Spermatic Artery 43
Cord 42, 94
Vein 43
Steele, Charles 176
Stoker, W. P. 195
Stokes, W. Prof. 193
Storer, H. R. 126
Sutures, Cat-gut 108, 165, 185, 190, 196, 235
Silk 177, 186
Tendon 85, 125, 161, 174, 182, 218, 235
Wire 109, 149, 154, 158, 163
Swenson 199, 205
Symptoms of Inguinal Hernia 48
Femoral Hernia 101
Obturator Hernia 114
Strangulated Hernia 64
Umbilical Hernia 120

T.

Tables 3, 5, 6, 7, 9, 181
Taxis 73
Transversalis Fascia 39
Muscle 38
Treatment of Wound 83, 85, 218, 237
Treves, F. 188
Tilanus, J. W. R. 182
Torsion of Sac 193
Trusses, Adjustment of 56
Difficulty of Retaining in Children 216
Kinds of 57
Stagner 57
Wood-pad 138

PAGES.

Tunica Vaginalis 21

U.

Umbilical Hernia.....120, 234

V.

Van Der Veer, A... 213
Vas deferens 42, 43
Ventral Hernia.....127, 236
Velpeau, M..... 144

W.

Walsham, W. J., Mr..... 197
Warren, J. Collins 134
Warren, Joseph H..... .....82, 145
Watson, J..... 145
Weir, Robert 208
Welsch, G..... 118
Wells, Spencer, Sir..... .....216, 238
White, H. C..... 126
Whitman, R..... 211
Wilcox, D. G. 213
Wilson, A. H..... 70
Wood John.....109, 148, 189
Wood Thomas..... 147
Wright, G. A..... 188
Wutzer..... 139
Wyman, Jeffreys..... 165

Y.

Young, Thomas..... 170

Z.

Zimmermann..... 24

COMPARATIVE

DIGESTIVE POWER OF PEPSINS.

R. H. Chittenden, Ph. D., Professor of Physiological Chemistry at Yale University, in a paper on Digestive Ferments, read before the New York Academy of Medicine, January 23, 1889, and published in the *Philadelphia Medical News*, February 16, 1889, says:

"As a final result, then, we may consider the true proteolytic power of the following pepsin compared with one of the highest digestive power to be as follows:

		Relative Proteolytic Action.
1	Parke, Davis & Co.'s Pepsinum Purum in Lamellis	100
2	Fairchild's Pepsin in Scale	52
3	Scheffer's Dry Pepsin, Concentrated	48
4	Jensen's Crystal Pepsin	35
5	Ford's Pepsin in Scales	32
6	North's Pure Pepsin	16
7	Boudault's Pepsin	14
8	Royal Chemical Co.'s Pure Pepsin	9

Other eminent investigators haye reached the same results as to the pepsin of the highest digestive power.

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